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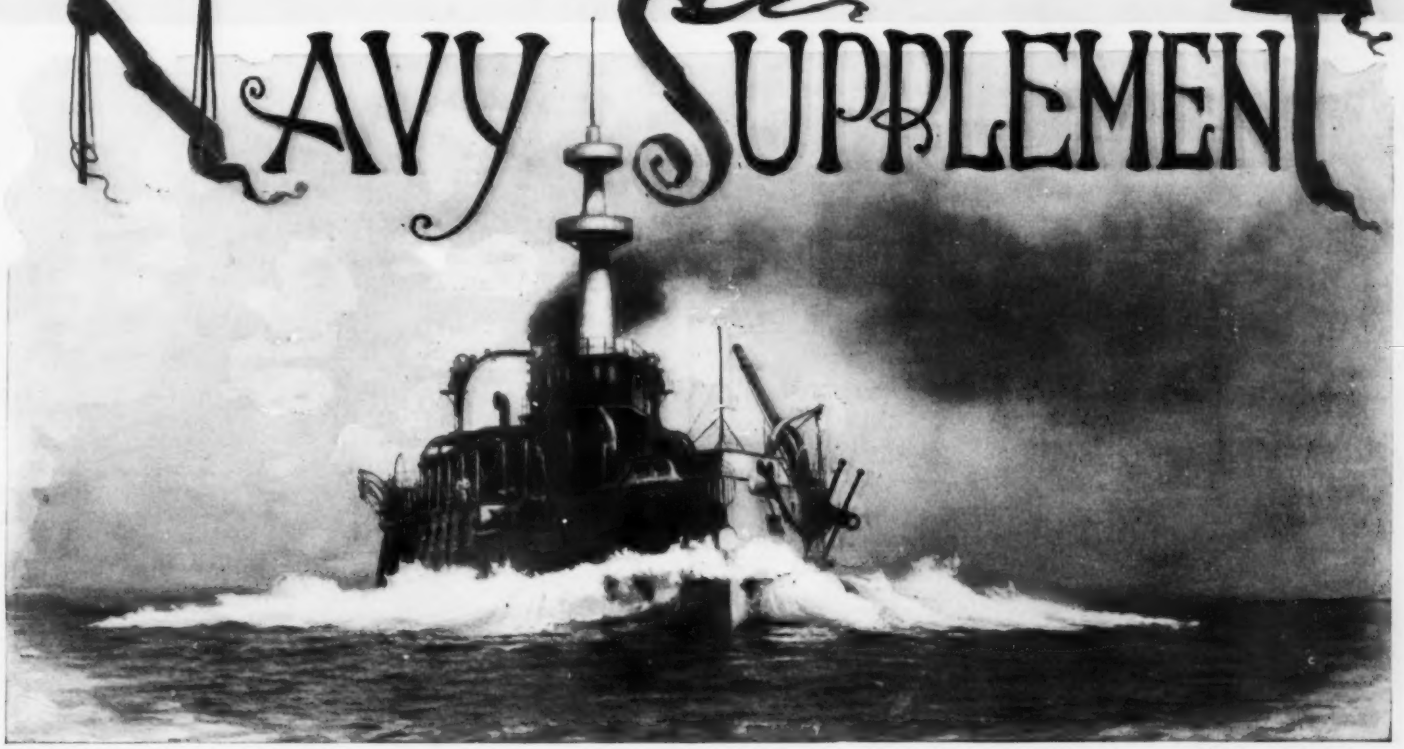
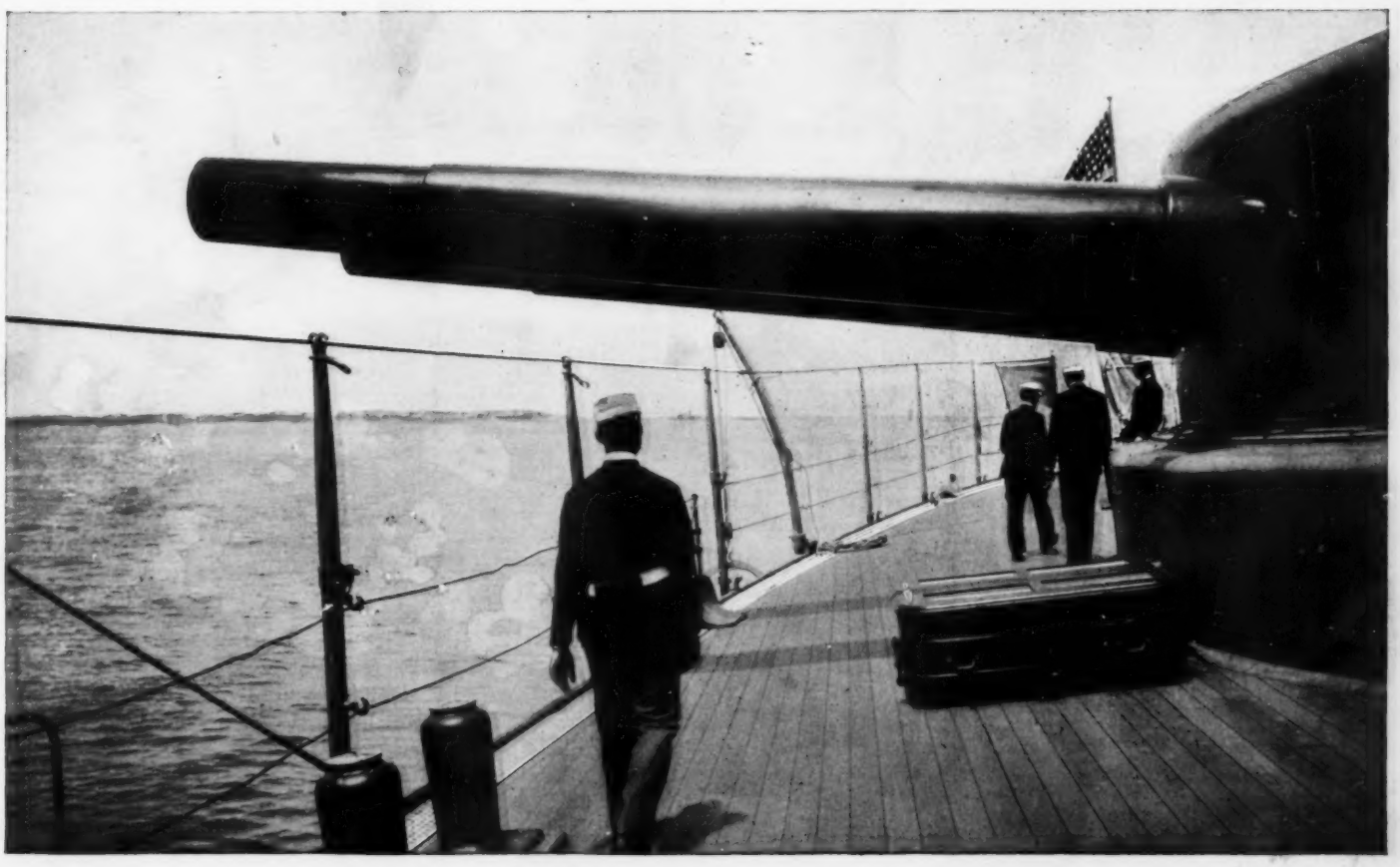


THE UNITED STATES BATTLESHIP OREGON.



BATTLESHIP INDIANA WITH 13-INCH GUNS SWUNG TO STARBOARD.

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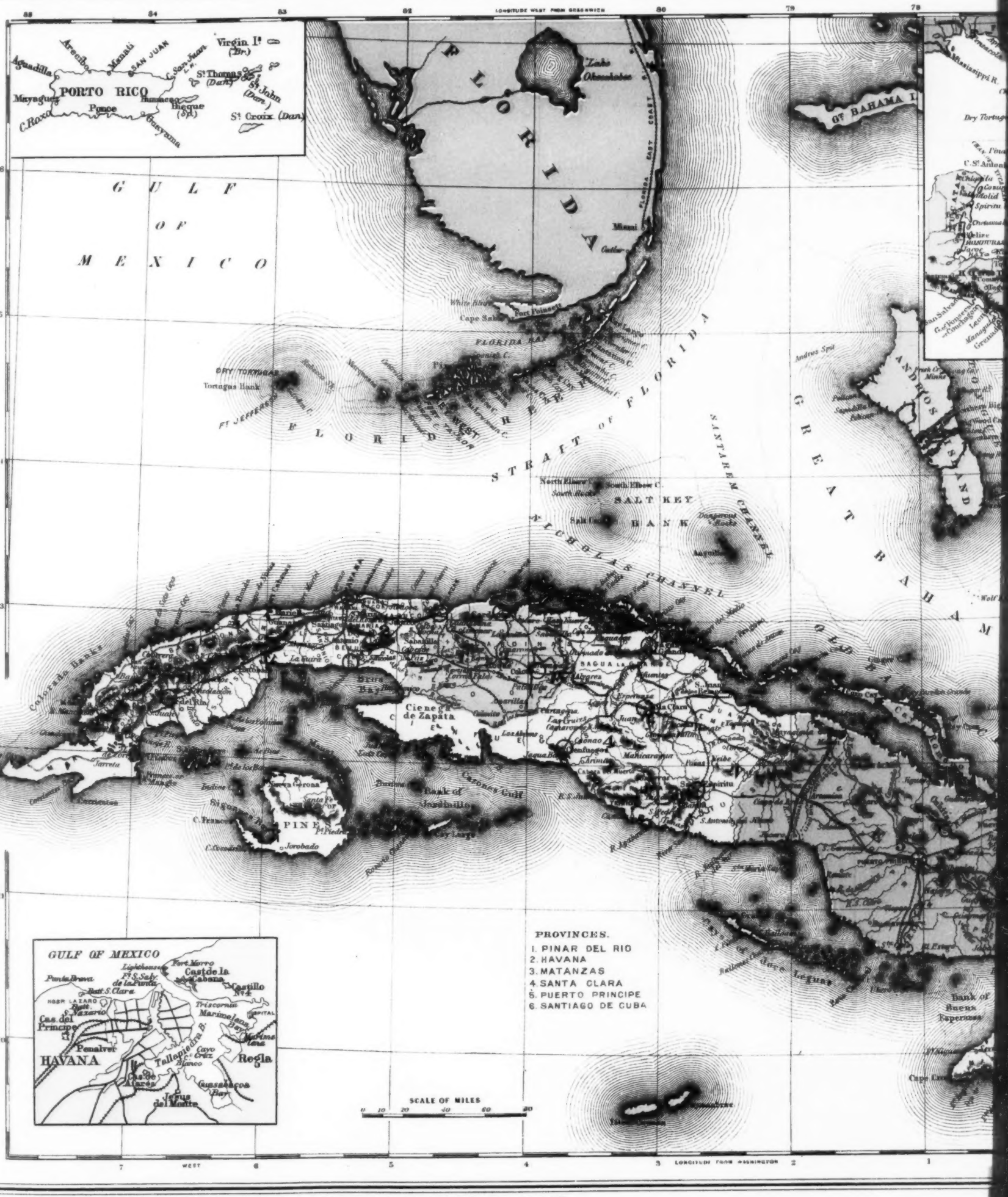
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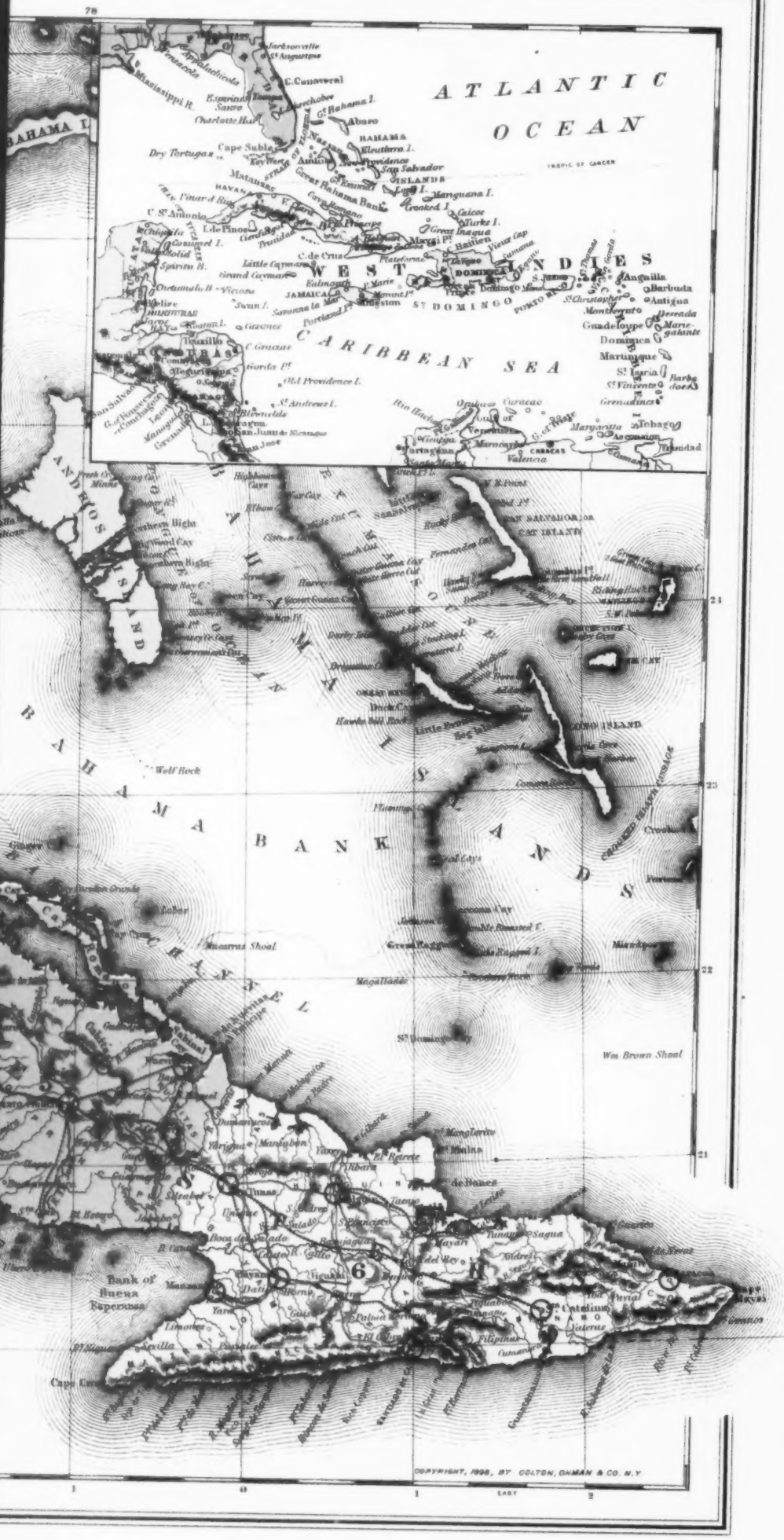
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Spirito N.
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Grand Cayman
Swan I.
Truxillo
C. Gracias
Garda Pt
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Cape Dame Marie
Port au Prince
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Caicos
Crooked I.
Mariguana I.
Great Inagua
Little Inagua
Great Bahama Bank
Cay Lobos
Cay Verde
Cay Sal
Cay Romano
Cay Sabinal
Cay Frances
Cay Coco
Cay Confites
Cay Megano
Cay Guajaba
Cay Guajabita
Cay Guajabon
Cay Cruz
Cay Caballeria
Cay Bretal
Cay Bretalito
Cay Paredon Grande
Cay Paredon Chico
Cay Romanito
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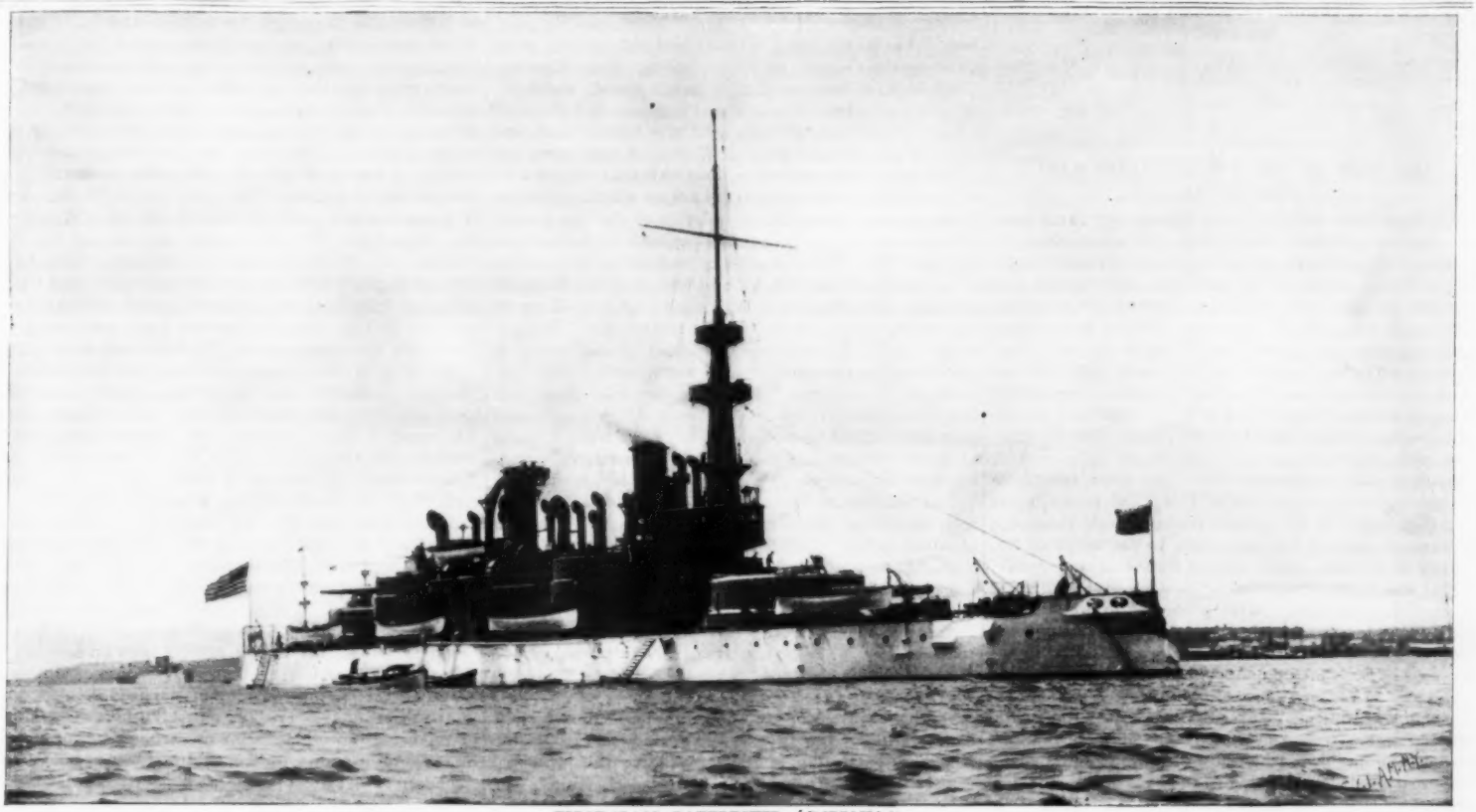

FIRST-CLASS BATTLESHIP "INDIANA."

Displacement, 10,288 tons. **Speed**, 15·5 knots. **Maximum Coal Supply**, 1,597 tons. **Complement**, 473. **Armor:** Belt, 18 in.; deck, 2¾ in.; barbettes, 17 in.; turrets, 15 in.; casements, 6 in. **Guns:** Main battery, four 13-in., eight 8-in., four 6-in. slow-fire; secondary rapid-fire battery, twenty 6-pounders, six 1-pounders, four Gatlings. **Torpedo tubes**, two. **Authorized** 1890.

"INDIANA"—FORWARD TURRET, LOOKING AFT FROM THE BOW.

SPECIAL NAVY EDITION
OF THE
Scientific American Supplement.
Vol. XLV., No. 1165.
APRIL 30, 1898.

MUNN & CO., . . . EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT
361 BROADWAY, NEW YORK.

TERMS.

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THE SHIPS OF THE UNITED STATES NAVY.

HISTORICAL.

FIFTEEN years ago the United States navy, in the modern sense of the term, did not exist. At a time when the other great maritime nations of the world were building powerful fleets of iron and steel battleships and cruisers, equipped with the latest products of the armor-plate mills and gun factories, the United States, bent upon enjoying the piping times of peace and with little thought or fear of foreign complications, paid little attention to its navy, and was, in consequence, represented upon the high seas by a fleet of antiquated wood frigates—ships which had been excellent craft in their day and generation, but which, in comparison with the up-to-date battleships of a later time, were altogether unworthy to represent this great nation upon the high seas. If the gentle reader should deem the picture overdrawn, let him listen to the words of Mr. Frank M. Bennett, of the United States navy, in speaking of the ships of that day: "A sense of humiliation dogged the American naval officer as he went about his duty in foreign lands. In the far East, in the lesser countries along the Mediterranean Sea, and even in the seaports of South America people smiled patronizingly upon him and from a sense of politeness avoided speaking of naval subjects in his presence. None but naval officers and a few Americans who happened to be abroad comprehended just how insignificant and cheap the great republic appeared in the eyes of the world at and about the time mentioned."

To anyone who is familiar with the glorious history of the American navy it seems incredible that, in the two decades that had intervened since the brilliant operations of the civil war, its status should have fallen to such a low degree. As a matter of fact, however, at the close of the war silence fell upon the busy dockyards of the navy—a silence which was to be practically unbroken for the next twenty years. All the accumulated experience of the previous four years, and the novel types of ships in which it was embodied, were laid open as a kind of reference library or school of instruction for the warship builders of the world at large. Foreign naval constructors were not slow to learn therein, and the student of naval progress must cross the water if he would follow the development of ships, guns and armor during the two decades which followed the close of the war. It was as though the nation, utterly sick and weary of the very suggestion of war, had banished all thought of its implements and material from its mind. The shipbuilders of the old world took up the task where we had laid it down, and industriously developed the fundamental ideas contained in our "Merrimac" and "Monitor."

Hence it was that the people of the United States found themselves, in the year 1883, to all intents and purposes, without a navy; and with the conviction that a start should at once be made in the work of reconstruction, an act was approved which authorized the building of three steel cruisers, two of which were to be of about 3,000 tons and one of about 4,500 tons displacement, together with a dispatch boat of about 1,500 tons. The construction of these ships was undertaken by John Roach. The "Dolphin" was completed in his yards; but, owing to the unfortunate failure of Mr. Roach before they were finished, the other three ships had to be taken over and completed by the government. The "Atlanta" and "Boston" were sister ships of what is now known as the protected cruiser type, in which protection against shell fire is afforded by a continuous curved deck of steel located at about the water line level. They were armed with 8-inch and 6-inch breech-loading rifles, and had a trial speed of about 15½ knots per hour, motive power being furnished by single screw horizontal compound engines.

The "Chicago" was also a protected cruiser, but was much larger and more powerful. Her armament consisted of four 8-inch, eight 6-inch and two 5-inch rifles, and her curious twin-screw compound overhead beam engines gave her a speed of about 16 knots per hour. All three of the ships were furnished with full sail power, the "Atlanta" and "Boston" being rigged as brigs and the "Chicago" as a bark. White was adopted as the color of the new navy, and the three vessels made an extremely handsome appearance, which quickly caught the eye and won the favor of the American people. The "Boston" has been in practically continuous service since her launch, and the "Atlanta" and "Chicago" are now at the New York navy yard, where they are being re-engined and boilered and are receiving a battery of modern rapid-fire guns.

Two years elapsed before Congress again supplemented its modest beginning of a navy by a further appropriation. In 1885 an act was passed authorizing the construction of two cruisers and two gunboats, in accordance with which the "Newark," a protected cruiser of 4,098 tons and 19 knots speed, and the gunboat "Yorktown," of 1,710 tons and 16·14 knots, were built by the Cramps, of Philadelphia. The "Charleston," of 3,730 tons and 18·20 knots speed, was built by the Union Iron Works, San Francisco, and the gunboat "Petrel," of 892 tons and 11·8 knots speed, was built by the Columbian Iron Works, of Baltimore.

The act of 1886 secured a most valuable addition to the small but growing navy by authorizing, in addition to several new ships, the completion of the five powerful monitors whose keels had been laid as far back as the year 1874. Work had been carried on upon them in a desultory manner, and, in 1886, they consisted of nothing more than the hull and engines. Four of these—the "Amphitrite," "Miantonomoh," "Monadnock" and "Terror"—are identical in size, being of 3,990 tons displacement. Their engines are of the old-fashioned twin-screw inclined compound type, but they have been overhauled and put in good shape and new boilers have been furnished. They have a speed of about 12 or 13 knots an hour and a powerful armament of four 10-inch guns. Protection is furnished by 7-inch continuous belts of steel and from 7½ to 11½-inch armor on the barbettes and turrets. The fifth monitor is the "Puritan," a powerful ship of 6,060 tons. As reconstructed, she carries the full battery of a first-class battleship, viz.: Four 12-inch guns and six 4-inch rapid-fire guns, and her armor is from 6 to 14 inches in thickness. Although the work on the monitors was one of reconstruction, it was probably the most valuable of all that was authorized in this year for the new navy.

The other provisions of the act of 1886 called for the construction of the "Texas," a second-class battleship (the first battleship of the new navy), the protected cruiser "Baltimore," the armored cruiser "Maine," the dynamite cruiser "Vesuvius" and the torpedo boat "Cushing." The plans of the "Texas" and the "Baltimore" were purchased in England. The "Texas" plans were drawn up by a well-known designer, William John, and the ship was built at the Norfolk navy yard. The "Baltimore" plans were purchased from the Armstrongs, and, after important changes had been made in them by the builders, the ship was constructed by the Cramps, of Philadelphia. In connection with this purchase of foreign plans, it must be borne in mind that steel warship construction was at this time a comparatively untried science and art in the United States, whereas the country from which the plans were purchased had been engaged in this class of work uninterruptedly for a quarter of a century. The "Texas" has had a somewhat checkered career; but the "Baltimore" won favor, both by her fine appearance and her performance, from the very day of her launch. The "Texas" is a 6,315 ton ship, of 17·8 knots speed, carrying two 12-inch guns in turrets within a central barbette of 12-inch steel, besides a secondary battery of six 6-inch guns. The "Baltimore" is a protected cruiser of 4,413 tons and over 20 knots speed. She carries four 8-inch and six 6-inch guns at a considerable elevation above the water line. In her the lofty masts and the yards which characterized the earlier cruisers disappear, and she carries simply two military masts provided with fighting tops.

The "Maine," like the "Texas," marked the introduction of a new type of ship into the new navy. She was known at the time as an armored cruiser, her protection consisting of a 12-inch belt of steel associated with a protective deck of 2-inch steel. The heavy armament of four 10-inch and six 6-inch guns really entitled the "Maine" to be called a second-class battleship. She was a vessel of 6,682 tons displacement and 17·45 knots speed.

The dynamite cruiser "Vesuvius" was given a displacement of 930 tons, and on her trial she showed a speed of 21·42 knots per hour. She was provided with pneumatic dynamite guns for the discharge of shells containing 200 pounds of dynamite. The guns were rigidly fixed three abreast in the bow, and they were trained on the target by the steering of the vessel. The torpedo boat, which was named the "Cushing," showed a speed of 22⅛ knots per hour.

Five vessels were authorized in the following year, the monitor "Monterey," of 4,084 tons and 13½ knots speed, built at the Union Iron Works, San Francisco; the protected cruiser "Philadelphia," of 4,324 tons and 19·68 knots speed, built at the Cramps; the protected cruiser "San Francisco," 4,098 tons and 19·53 knots speed, built at the Union Iron Works, San Francisco; and the gunboats "Concord" and "Bennington," of 1,710 tons and about 17 knots speed, built at Chester, Pennsylvania.

The following year, 1888, saw the good work of building up the navy still going on apace, and no less than eight ships were authorized. Of these the most notable and successful was the armored cruiser "New York." She marked a great advance in size and speed over anything that had yet been attempted, her displacement being 8,200 tons and her speed 21 knots. The "New York" marked the point at which our ships began to take on a clearly defined individuality of their own, and those features of heavy armament, powerful and thorough protection and high speed which characterize our vessels were all conspicuous in this fine ship. She carries as her main armament six 8-inch rifles in steel barbettes, besides twelve 4-inch rapid-fire guns in the secondary broadside battery. A premium of $50,000 for every ¼-knot in excess of the contract speed of 20 knots won for her builders, the Cramps, a bonus of $200,000. Equally successful was the protected cruiser "Olympia," of 5,870 tons and 21·78 knots speed, built by the Union Iron Works, of San Francisco. For this speed she earned for the builders the enormous bonus of $300,000. Two sister ships, the protected cruisers "Cincinnati" and "Raleigh," of 3,213 tons and 19 knots speed, were also authorized in this year, the former being built at New York and the latter at the Norfolk navy yard. The other ships of the programme were the three cruisers "Detroit," "Marblehead" and "Montgomery," of 2,089 tons and 18½ knots speed, and the training ship "Bancroft." The "Detroit" and "Montgomery" were built at the Columbian Iron Works, Baltimore; the "Marblehead" by Loring, of Boston; and the "Bancroft" by S. L. Moore & Sons, Elizabethport, N. J.

In the year 1889 two gunboats, the "Castine" and "Machias," of 1,177 tons and 16 knots speed, were authorized, together with the harbor defense ram Katahdin. All three vessels were built by the Bath Iron Works, Bath, Me. The ram was formerly known as the "Ammen," after Rear Admiral Ammen, United States navy, her designer, who has always been an ardent advocate of the ram for offensive purposes. This is a strictly original craft, nothing of the kind being found in any other navy. It relies entirely upon the ram for its offensive power, the armament consisting of a few light rapid-fire guns, for use against torpedo boats.

The next decade opened with brilliant promise for the future of the new navy. In the year 1890 was passed an act authorizing the construction of three first-class battleships, a protected cruiser of 7,300 tons and 21 knots speed, a 750 ton torpedo gunboat and a torpedo boat. This resulted in due course in the addition to the navy of the "Indiana," "Massachusetts" and "Oregon"—the three most powerfully armed and armored ships in the world—together with the "Columbia," the swiftest cruiser of her size afloat, and the torpedo boat "Ericsson." The "Indiana," "Massachusetts" and "Columbia" were laid down at the Cramps' yard and the "Oregon" at San Francisco. The "Ericsson" has the distinction of being built in the very heart of the United States—at Dubuque, Ia., from which place she was brought to the seaboard by way of the Mississippi. It was in the design and construction of this remarkable quartette of big ships that the United States showed to the world that they had lost none of their former originality and skill in naval construction. The combined efforts of such men as Hichborn, Bowles, Melville, Sampson, and Harvey of armor plate fame, had produced in a brief half dozen years warships which, in power to steam far and fast and give and take the hard blows of a naval fight, were far in advance of anything afloat at that day. The "Columbia" to-day holds the naval record for continuous sea speed across the Atlantic, having crossed at the average rate of 18·41 knots for the whole distance; and on her trial trip she eclipsed all previous records for speed by maintaining an average of 22·8 knots on a four hours' continuous trial. This performance secured for her builders a bonus of $350,000. Elsewhere in this number will be found a detailed description of the ships of this programme, and it must suffice us to say, in this article, that some of the improvements incorporated in the "Indiana"—notably the use of Harvey steel—marked an advance in naval construction comparable only to the appearance of Ericsson's Monitor, some thirty years before.

In the following year Congress was apparently satisfied to authorize the construction of only one ship, the "Minneapolis," a sister to the "Columbia." She was built at the same yard and achieved a speed of 23·07 knots on a four hours' trial run.

The year 1892 was marked by the authorization of one sea-going battleship and one armored cruiser. The result is seen in the "Iowa" and the "Brooklyn." The "Iowa" is of 11,340 tons displacement and about 16 knots speed, as against 10,288 tons displacement for the "Indiana" type. Her armor was lighter, but of greater resisting quality; and to give her better sea-going qualities she was given higher freeboard, her forward 12-inch guns being carried about 8 feet higher than those of the "Indiana." The "Brooklyn" is an

enlarged "New York." Her displacement is 9,215 tons; speed, 21·91 knots, and protection is afforded by a belt of 3 inch steel associated with a deck of steel from 3 inches to 6 inches in thickness. Like her prototype, she carries a main armament of 8-inch guns, of which she has 8 disposed in four steel turrets; she also carries twelve 5-inch rapid-fire guns. These are two of the most popular ships of the new navy, and are probably the best known of our later war vessels in Europe, the "New York" having represented this country at Kiel at the opening of the Baltic Ship Canal, the "Brooklyn" doing duty at the Jubilee naval review last year in Great Britain.

In 1893 Congress authorized the construction of three gunboats, the "Nashville," "Wilmington" and "Helena," each of 1,392 tons displacement and from 15 to 16 knots speed. They are given considerable beam and shallow draught and are designed for operations in shallow harbors and rivers, for which purpose, also, they are furnished with twin rudders of considerable area. In this year, also, authority was given to construct a submarine torpedo boat of the Holland type. This craft is nearing completion at the Columbian Iron Works, Baltimore, and for details of her construction the reader is referred to the illustrated description given elsewhere in this issue.

In the following year the navy secured the very modest addition of three torpedo boats, the "Foote," "Rodgers" and "Winslow," each of 142 tons and 24½ knots speed. The contract was given to the Columbian Iron Works, Baltimore.

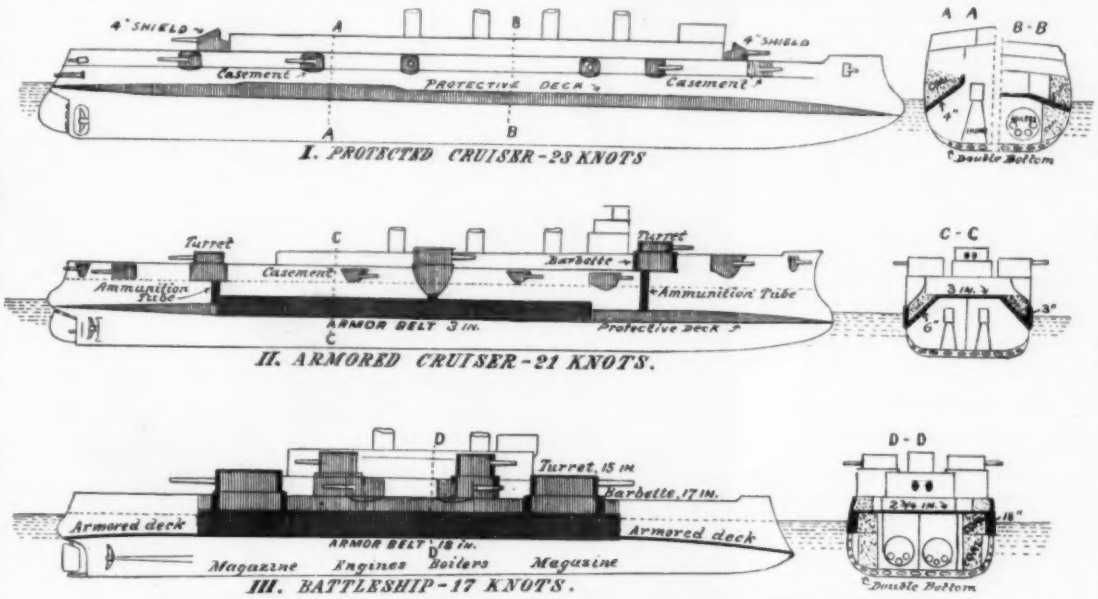
In 1895 the good work of building up our first line of battle was again taken up, an appropriation being authorized for building the two first-class battleships "Kentucky" and "Kearsarge," each of 11,525 tons and 16 knots speed. These fine ships, which have just been launched, are armed like their predecessor with 13-inch and 8-inch guns, the latter being superimposed upon the former in double-deck turrets. They carry an amidship broadside battery of fourteen 5-inch rapid-fire guns and mark a considerable advance in efficiency upon the earlier ships. The double-deck turrets were adopted after much debate among our naval experts, and their performance will be watched with much curiosity. In the same year six light-draught gunboats of composite construction were ordered, which are known as the "Annapolis" class. They are of 1,000 tons displacement and carry a battery of 4-inch rapid fire guns. Our torpedo boat flotilla was also strengthened by the addition of three torpedo boat destroyers, the "Porter," "Dupont" and "Rowan," of 27½ knots speed and about 190 tons displacement. These were our first attempts in the direction of the larger and faster types of torpedo boats, and the "Porter" achieved a speed of 28·63 knots, or 1·13 knots in excess of her contract speed. The contract for the "Porter" and "Dupont" was let to the Herreshoff Company, Bristol, R. I., and the "Rowan" was allotted to the Moran Brothers Company, of Seattle.

In 1896 the authorizations were made for a building programme which is now well under way. Its most important feature is the three powerful sea-going battleships "Alabama," "Illinois" and "Wisconsin," of 11,525 tons displacement and 16 knots speed. These ships have the high freeboard which characterizes the "Iowa," but their batteries are far more powerful, consisting of four 13-inch rifles and fourteen 6 inch rapid-fire guns disposed on two decks. The belt, barbette and casement armor is of face-hardened Harvey steel, and the protection is probably the most complete that was ever put upon a battleship. The "Alabama" is being built by the Cramps, the "Illinois" by the Newport News Shipbuilding Company, and the "Wisconsin" by the Union Iron Works. In the same year contracts were let for the construction of three first-class torpedo boats of 30½ knots, three of 22½ knots and four of 20 knots speed. The competition for the construction of this batch of torpedo boats brought into the field another Pacific coast firm, Wolff & Zwicker, of Portland, Oregon.

The torpedo boat fleet was increased in the following year by the authorization of three large and fast destroyers—the "Stringham," the "Goldsborough" and the "Bailey." The first of 340 tons displacement and 30 knots speed and the other two of 247 and 235 tons and 30 knots speed.

The appropriation recommended on April 1 of this year calls for the construction of three first-class battleships of 12,000 tons displacement; twelve torpedo boat destroyers and twelve torpedo boats. The addition of twenty-four torpedo craft fills a serious gap in the otherwise very complete classification of the ships of the United States navy. Judged by the proportions adopted in the other navies of the world, we have always been weak in the matter of torpedo boats and destroyers. When the programme of construction above given has been completed, however, we shall possess a fleet of twenty-six torpedo boats and twenty destroyers of from 29 to 31 knots speed.

At the opening of this brief historical review of the navy we found that America was practically unrepresented upon the high seas. At its close we find her possessed of a small but compact and homogeneous fleet containing some of the most efficient ships in the world. In 1883 we were not merely without the ships, but without the tools, the plant or the knowledge necessary to their construction. The task of creating a modern navy involved the task of creating the costly plant for the manufacture of ships, guns and armor. The double duty was confidently undertaken, and, working with a free hand, we have taught the nations of the old world better and cheaper methods of manufacture, and have thereby repaid many times over the assistance and suggestions which were rendered in the earlier years of our progress.



I. PROTECTED CRUISER - 23 KNOTS

II. ARMORED CRUISER - 21 KNOTS.

III. BATTLESHIP - 17 KNOTS.

COMPARATIVE ARMOR PROTECTION IN PRINCIPAL TYPES OF MODERN WAR VESSELS.

(All parts above the water line, shown by dotted lines and light shading, might be shot away without destroying the fighting power of the ship.)

THE INVULNERABLE, FLOATING FORT, WITHIN THE OUTER WALLS OF A MODERN BATTLESHIP.

THE CONSTRUCTION AND CLASSIFICATION OF MODERN WARSHIPS.

THE modern warship is an ever popular subject with the readers of the illustrated press. This is proved by the tenacity with which guns, ships and armor hold their place as conspicuous subjects for the pen and the brush. It is a question, however, in spite of the familiarity of the public with the technical phraseology of the warship, whether the average reader has a very accurate idea of the distinctions between the various classes of ships and between the various elements from the combination of which these ships derive their distinctive class characteristics. He is told that the "Indiana" is a battleship, the "Brooklyn" an armored cruiser, the "Columbia" a protected cruiser, and the "Puritan" a monitor. But it is probable that he has only a vague idea as to what qualities it is that mark the distinction, or why the distinctions should need to exist at all.

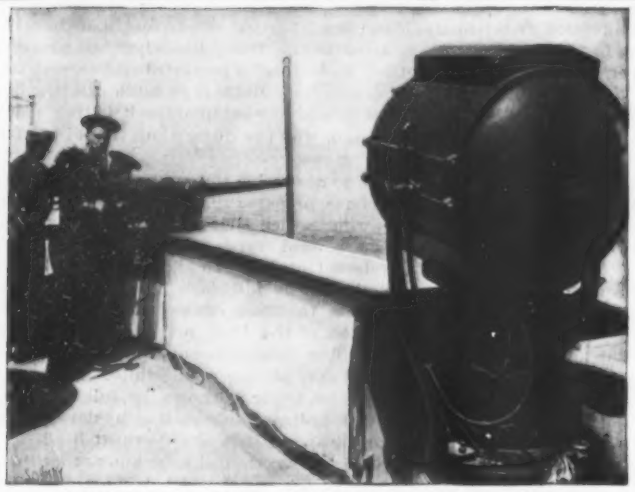
With a view to answering these questions in a general way, we have prepared three diagrams and a perspective drawing which show the constructive features of the several types of warship to which we have referred above. In diagrams 1 to 3 the armor is indicated by full black lines or by shading, the approximate thickness of the armor being shown by the thickness of the lines and the depth of the shading. The fine lines represent the unarmored portions or the ordinary plating of the ships. In the perspective view the armor is shown by full lines and shading and the ordinary ship plating by dotted lines.

When the naval architect sits down at his desk to design a warship of a certain size, he knows that there is one element of the vessel which is fixed and unalterable, and that is her displacement. By displacement is meant the actual weight of the ship, which is, of course, exactly equal to the weight of water which she displaces. This total weight is the capital with which the architect has to work, and he uses his judgment in distributing it among the various elements which go to make up the ship. Part is allotted to the hull, part to the motive power, part to the armor protection, part to the guns, and part to the fuel, stores, furnishing and general equipment.

It is evident that the allotment of weights is a matter of compromise—whatever excess is given to one element must be taken from another; else, the ship will exceed the given displacement. Among the elements above mentioned there are some, such as weight of hull, provisions, stores, and furnishing, which for a given size of ship will not vary greatly. There are other elements, such as guns, armor, engines and fuel-supply, which may vary considerably in different ships, according to the type of vessel that is produced. If, for instance, the architect is designing an extremely fast ship of type No. 1, which has a speed of 23 knots, he will have to allot such a large amount of weight to the motive power that he will only be able to give the ship very slight armor protection and a comparatively light battery of guns. If he wishes to produce a fast ship that shall be more heavily armed and armored, he has to be content with less speed, say 20 or 21 knots, as in No. 2, and the weight so saved on the motive power appears in the shape of a side belt of armor at the water line, more complete protection for the guns in the shape of barbettes and turrets and considerably heavier armament. If, again, he desires to produce a ship capable of contending with the most powerful ships in line of battle, as in No. 3, he is content with much lower speed, say 16 or 17 knots an hour, and he increases the power of his guns until they weigh over 60 tons apiece, and protects them with great redoubts and turrets of steel 1⅛ feet thick, besides protecting his water line in the region of the engines and boilers with a belt of steel of the same dimensions.

The swift and lightly armed and armored ship is known as a protected cruiser; the less speedy but more heavily armed and armored ship belongs to the armored cruiser type, and the slowest ship, with its capacity for taking and giving the heaviest blows that modern guns can inflict, is known as a battleship.

In the construction of a warship the two qualities of attack and defense have to be supplied. The offensive powers are furnished by the guns, the torpedoes and



"INDIANA"—A 100,000 CANDLE POWER SEARCH LIGHT.

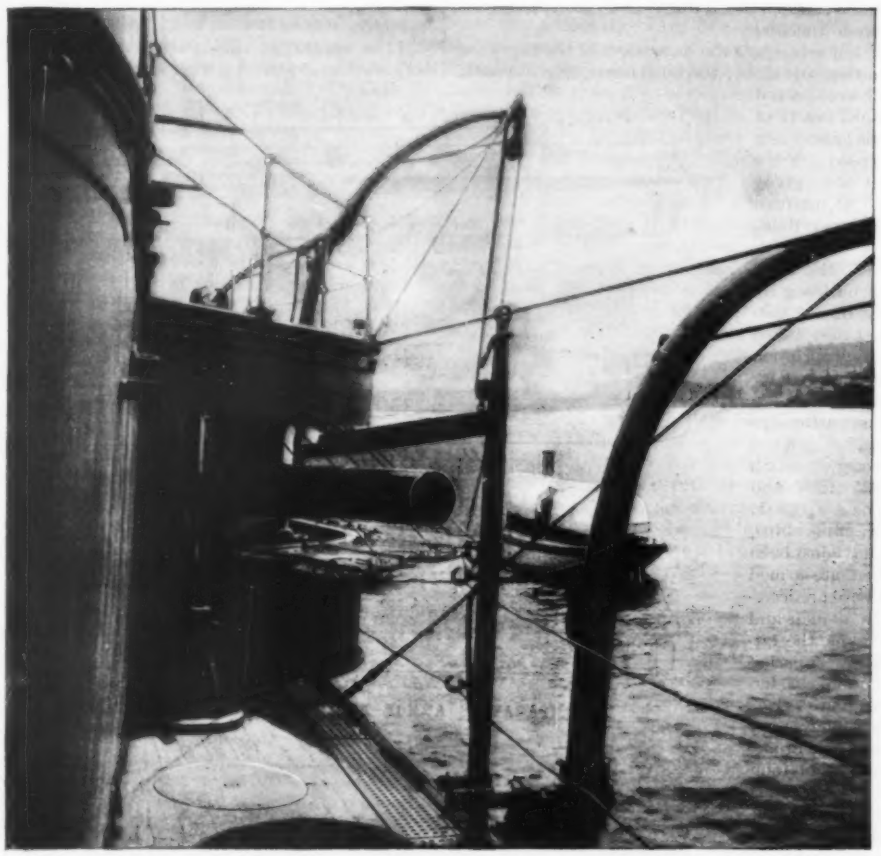
at a slightly higher level than the water line amidships, and it curves down at each end to meet the bow and the stern. In the battleships this deck is generally flat from side to side amidships for about two-thirds of the ship's length. At the sides it rests upon a wall of vertical armor from 15 to 18 inches in thickness, which extends in the wake of the magazines, engines and boilers. This side armor is usually about 7½ feet in height, 3 feet of it being above and 4½ feet below the water line. At each end of the side armor a transverse wall of armor extends clear across the ship. This rectangular wall with its roof of 3-inch steel thus forms a kind of inverted box, snugly sheltered below which are the before mentioned "vitals" of the ship. At each end of this inverted box two huge barbettes, with walls 15 to 17 inches thick, are built up to a few feet above the main deck, and just within and above them revolve a pair of turrets

"INDIANA" SIGHTING THE GUNS IN THE SIGHTING HOOD OF 13-INCH GUN TURRETS.

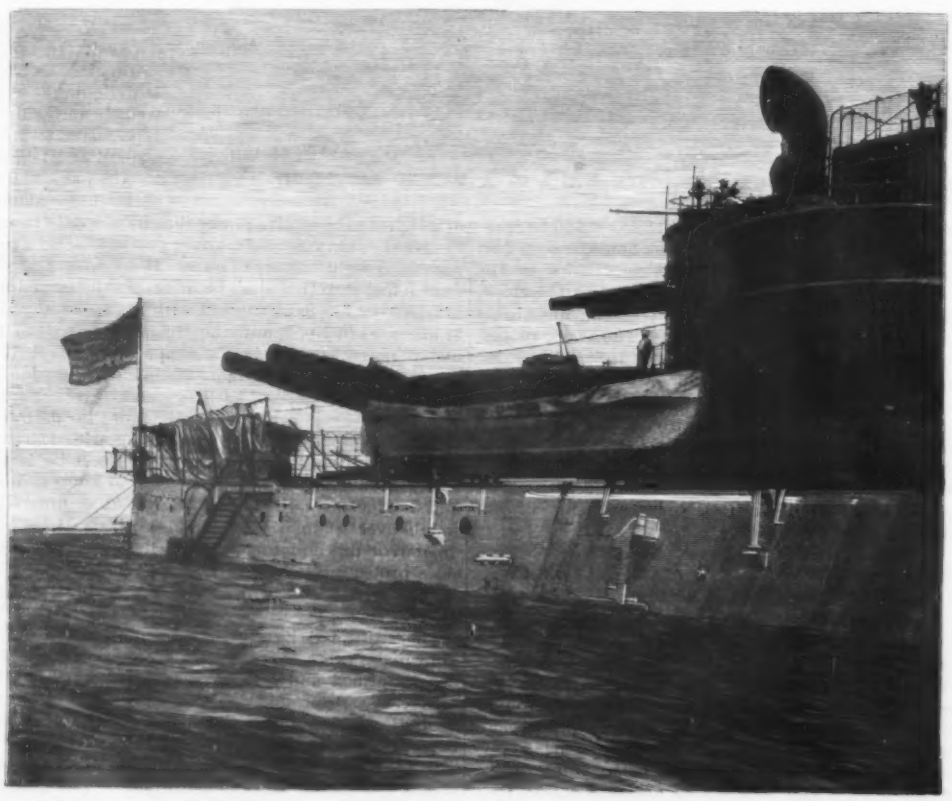
the ram; the defensive powers are provided by giving the ship a complete double bottom and an abundance of watertight compartments, and by providing it with as much armor plating as it will carry to keep out the shells of the enemy. The greatest danger to which a warship is exposed is that of being sunk either by under-water attack by torpedoes or the ram, or by being penetrated at the water line by heavy shell-fire. The destructive force of a torpedo is so great that all that can be done is to localize its effects. For this purpose, and also to give greater structural strength, the hull below the water line is built double—a hull within a hull. The longitudinal and transverse plate framing of the ship is built in between these shells, which are known as the inner and outer bottoms, and the space is thus divided into innumerable watertight compartments or cells. There is a possibility that a blow that would burst in the outer shell might not rupture the inner shell; but if it should, the inflow of water is confined to a limited portion of the hull by dividing the latter by transverse and longitudinal walls or bulkheads of plating. A blow that burst in both outer and inner shells would only admit water to one of many compartments, and the ship would still have a large reserve of buoyancy.

In protecting warships against shell-fire it is recognized that there are certain parts of the ship which are of paramount importance, inasmuch as their disablement would leave it at the mercy of the enemy. These are the "vitals" of the ship, and they comprise the magazines, the boilers, the engines and the steering gear. If a shell penetrated the magazines, it would be liable to result in the blowing up of the whole ship, and if it entered the boiler, engine or steering rooms, it would probably render the ship unmanageable, in which event she would run the risk of being rammed and sunk by the enemy.

In all warships the vitals are covered by a complete protective deck of steel, which varies in thickness from 1½ to 3 inches. The highest part of the deck is generally



"INDIANA"—EXTERIOR VIEW OF 6-INCH GUN AND CASEMENT.



"INDIANA"—THE STARBOARD QUARTERS, SHOWING THE 13-INCH, 8-INCH AND 6-INCH GUNS.

with walls of 15 to 17 inch steel. (See perspective view.) The turrets give shelter to the big guns, of which there are a pair in each, and the barbettes protect the turning gear by which the turrets are rotated. There is thus a continuous wall of 15 to 17-inch steel extending from 4 feet below the water line to the roofs of the turrets.

With this description in mind the reader will see, on looking at diagram No. III., that before heavy shells can injure the engines, boilers or guns, they must pass through from 15 to 18 inches of solid and, in the case of American battleships, face-hardened Harvey steel. The 6-inch and 8-inch guns are protected by 6 and 8 inches of steel.

Now it can readily be understood that all this amount of heavy armor and guns adds greatly to the weight of the ship, and for this reason, in spite of her smaller engine power, a first-class battleship rarely displaces less than 10,000 tons, and in some foreign navies the displacement runs up to nearly 16,000 tons. This will be understood by reference to the perspective view, where the armored portions of the ship are indicated by full lines and shading, the ordinary shell plating being dotted. It will be seen that all that part of the ship lying below the water line is shut in by a continuous roof of steel which is 3 inches in thickness forward and aft of the bulkheads. Over the central armored citadel it is 2¾ inches thick. All the plating indicated by dotted lines might be shot away without the "vitals" suffering injury or the ship being sunk. The reader will see that it is its loftier sides and the extra deck and freeboard which they provide which constitute practically the difference between a battleship and a monitor.

This brings us to the consideration of the monitor type. Take away from a battleship all that portion which is shown in our drawing in dotted lines above the water line; lower the barbettes until they rise only a few feet above the steel deck, and we have a ship of

the general monitor type. The monitor is distinguished by very low freeboard—only a few inches in the extreme type—the absence of a heavy secondary battery and the possession of a main armament of heavy guns. Such a ship labors heavily in bad weather and is not intended for service at any distance from the coasts. To make a seagoing vessel out of her it would be necessary to add one, or even two decks, placing the guns well up above the water, after which changes she would be no longer monitor, but seagoing battleship.

In the cruiser type the protective deck does not extend across the ship at one level, but curves down to meet the hull at a point several feet below the water line. This sloping portion is made thicker than the flat portion, as in diagram No. II., where the deck is 3 inches thick on the flat and 6 inches on the slopes. In the case of the armored cruisers, a belt of vertical armor is carried at the water line and in all cruisers the V-shaped space between belt and sloping deck is filled in with coal or with some form of water-excluding material, such as cornpith cellulose. In diagram II., which represents the fine armored cruiser "Brooklyn," it will be seen that before it could reach the engine room a shell would have to pass through 3 inches of vertical steel, about 6 feet of coal and 6 inches of inclined armor—a total resistance equal to 14 or 15 inches of solid steel. The guns and turning gear are protected by 5½-inch steel turrets and 8-inch barbettes. The barbettes, it will be seen, do not extend continuously down to the armored deck, as in the battleship, for this would require a greater weight of armor than can be allowed. Consequently, the architect is only able to furnish the guns with a small armor-plated tube for protecting the ammunition in its passage from the magazines to the barbettes.

"INDIANA"—LOADING THE AMMUNITION HOISTS FOR 13-INCH GUNS.

In the protected cruiser the side armor at the water line disappears altogether, and dependence is placed entirely upon the sloping sides of the protective deck, the water-excluding cellulose and the 6 or 8 feet of coal which is stowed in the bunkers in the wake of the engines and boilers. The barbettes, turrets and armored ammunition tubes of the armored cruiser disappear, and their place is taken by comparatively light shields and casements of 4-inch steel which serve to protect the gun crews.

It will be seen from the above description that each class of vessel is only fitted to engage ships of its own type. The protected cruiser "Columbia" (No. I.) might, with her light 6 and 4-inch guns, hammer away all day at the "Indiana" (No. III.) without being able to do much more than knock the paint off the latter's 18-inch armor, whereas one well-directed shot from the 13-inch guns of the "Indiana" would be sufficient to sink or disable the "Columbia." The "Brooklyn" would fare better, and at close range her 8-inch guns might happen to penetrate the belt or turret armor of the "Indiana," but the issue of the duel would never be in doubt for an instant. A "Columbia" or a "Brooklyn" would show its heels to an "Indiana" or "Massachusetts," and their great speed would give them the option of refusing or accepting battle with almost any craft that is afloat upon the seas to-day.

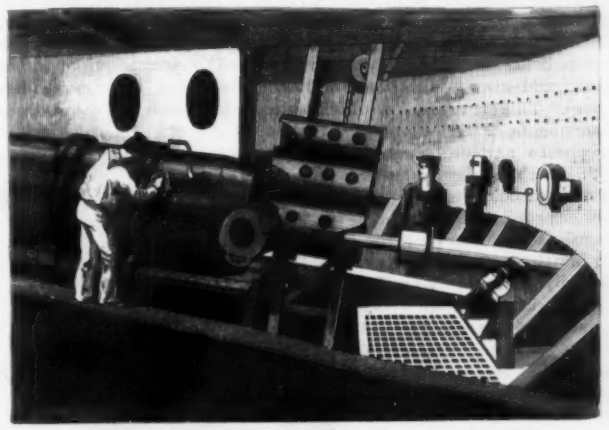
It should be mentioned, in conclusion, that the dividing lines in the classification of warships are somewhat flexible. We may find a battleship like the 12,950-ton "Yashima" (Japanese), with a trial speed of 19½ knots. On the other hand, we see cruisers like the "Vizcaya" (Spanish), with a 12-inch belt and carrying heavy guns of 11-inch caliber.

BATTLESHIPS.

THE battleship and the cruiser of a modern navy hold the same mutual relation as the three-decker and the swift frigate in the days of the sailing ship. When a fleet set sail in the olden days to find the enemy and bring him to battle upon the high seas, the heavy and somewhat slow line-of-battle ships kept together in a methodical formation, while the frigates cruised at a distance of several miles, where they could report the first appearance of the enemy and signal to the main fleet his position and maneuvers. When the main fleets had been brought within striking distance, the brunt of the battle fell upon the three-deckers. To-day the swift protected cruiser will perform the same duties for the heavily armored and more cumbrous battleships. When the attack takes place, it will be the battleships and armored cruisers that will decide the issue. Hence the battleships will constitute a nation's main line of offense and defense upon the sea. A cruiser will avoid engagement with a battleship—it will be no disgrace to her if she shows it a clear pair of heels, trusting to her great speed for safety; for she could neither hope to pierce the armor nor resist the great guns of the heavier ship.

The battleship (see Fig. 3, page 3) is built to fight. It is designed with this sole object in view, and it must be prepared to fight at any time, and if need be, against big odds. It has great offensive power and equally great powers of resistance.

There has been only one great naval fight between modern warships—the battle of the Yalu, between the Japanese and Chinese fleets—and the most, by far the most, important fact developed by that engagement was the correctness of the theories upon which modern battleships are designed. The brunt of the Japanese attack fell upon two somewhat antiquated battleships, the "Ting Yuen" and "Chen Yuen," and for several hours the swift Japanese cruisers circled around these two grim ships of war, pouring in a perfect hail of rapid-fire shells, with occasional shells from their great 66-ton guns; yet the two battleships came out of the fight with their armor and big guns practically intact. The same deadly concentration of shell-fire would have sunk a whole fleet of cruisers. Had the Chinese battleships been manned by better crews, the Yalu would have had another ending.



RAMMING HOME THE CHARGE IN A 13-INCH GUN.

The new navy of the United States is relatively strong in battleships. We have now twelve first-class ships of this type either built, building or authorized. Four, the "Indiana," "Massachusetts," "Oregon" and "Iowa," are in commission; two, the "Kentucky" and "Kearsarge," are launched; three, the "Alabama," "Illinois" and "Wisconsin," are about half completed, and three others are authorized.

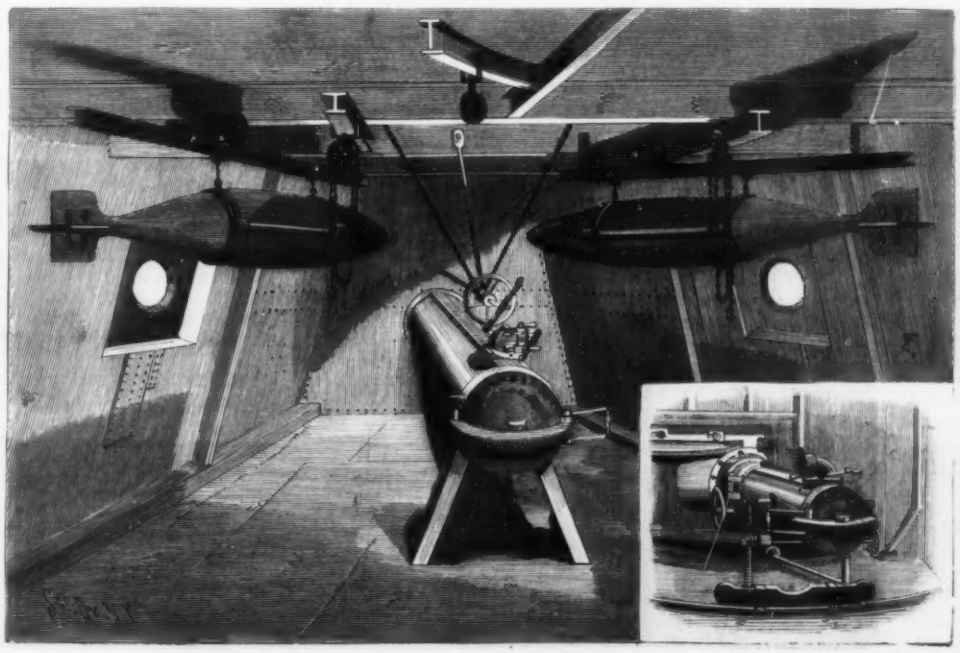
FIRST-CLASS BATTLESHIP "INDIANA."

The following description of the "Indiana" will apply in almost all particulars to the sister ships "Massachusetts" and "Oregon," the three ships having been built from the same plans.

A visitor on approaching the battleship "Indiana" by water, as she lies at anchor in a roadstead, is first of all impressed with the power of destruction which is suggested by the gleam of the many pairs of long and powerful guns with which she fairly bristles. They are her distinguishing feature, and mark the "Indiana" as the most powerful fighting machine in the world to-day. Not only is she able to give the hardest blows, but she could stand more hammering than any other ship. There are faster battleships, and bigger, but none that could hit so hard or endure so long.

Together with the "Massachusetts" and the "Oregon," she was built for the defense of the maritime cities and harbors. The trio might aptly be termed the watch dogs of the coast.

Looking at her massive form, it is difficult to realize that she has greater bulk below than above water. The floor of the outer shell of the hull lies 24 feet below the water line, and is some 348 feet long and 69¼ feet



"INDIANA"—BOW TORPEDO ROOM. BROADSIDE TORPEDO TUBE.

broad at its widest part. Within the outer shell, and 3½ feet distant from it, is an inner shell, each being watertight, and forming a complete ship's hull in itself. The space between the two is divided longitudinally by the plate frames (answering to the wooden ribs of the old three-deckers), which are riveted to both shells. These lateral spaces are again subdivided by a series of plate frames, or girders, which run the length of the ship, being riveted to the cross girders at the intersection, and also to the inner and outer "skin" of the ship. This arrangement cuts the space into small compartments, or "cells," each separate and watertight. The double bottom constitutes the below-water armor or protection of the ship against the torpedo, for while the explosion of these deadly weapons might break in the outer skin, the inner skin would possibly remain intact, and the flooding would be confined to the cells in the neighborhood of the explosion. If the inner skin should be broken, the inflow of water would be localized by the athwartship and longitudinal watertight bulkheads which extend above the water line.

The double skin rises to within 4½ feet of the water line, where it forms a shelf, upon which is carried a wall of Harvey steel armor 7½ feet high, 18 inches in thickness, and extending amidships for two-thirds of the length of the ship. At each end of the side walls is a transverse wall of steel, slightly thinner, but of the same height. The roof of this great rectangular fort is formed of 2¾ inches of steel, and down below its safe shelter are placed "the vitals," that is, the engines, boilers and stores of shot and shell. Forward and aft, beyond the 18-inch side belt, the steel deck is extended in a gradual curve to meet the bow and stern. The 2¾-inch steel deck is known as the berth deck, and some eight feet above it is the main deck, which extends flush throughout the ship, and finishes the hull proper. The line of this deck may be easily traced in the illustration, page 1, showing the ship at anchor. Between the top edge of the 18 inch belt and the main deck the protection consists of 5 inches of steel, backed by some 10 feet of coal, which will together keep out all the rapid-fire shells and such of the heavier shells as are fired from long ranges, or strike obliquely to the armor—as many of them will.

If we walk along the main deck to the starboard bow and look back, we get view shown on page 1. The most striking objects in this view are the muzzles of two of the 13-inch guns of the main battery, which show their black mouths protruding 23 feet through the ports of the revolving turret.

The turret consists of a solid circular wall of steel 17 inches thick, which revolves upon a circular track, located just below and within the top edge of a circular steel fort or barbette 17 inches thick, which is built up from the 18-inch armor belt below. It will thus be seen that from the top of the turret down to 4½ feet below the water line there is a continuous wall of steel

"INDIANA"—BROADSIDE 6-POUNDER RAPID-FIRE BATTERY.

17 and 18 inches thick for the protection of the gun-crew, the turning machinery and the powder and shell. In the uncertainties of war it is not likely that one shot in thirty that struck this turret would effect an entrance; and experience shows that not one-fourth of that number would probably score a hit in half a day's fighting, if the battle of the Yalu is anything of a guide. Just over the muzzle of the starboard gun is seen the turret sighting hood with its two horizontal and two vertical slots, or peepholes, from which the gunner watches the enemy, and by means of convenient levers, trains and fires the guns.

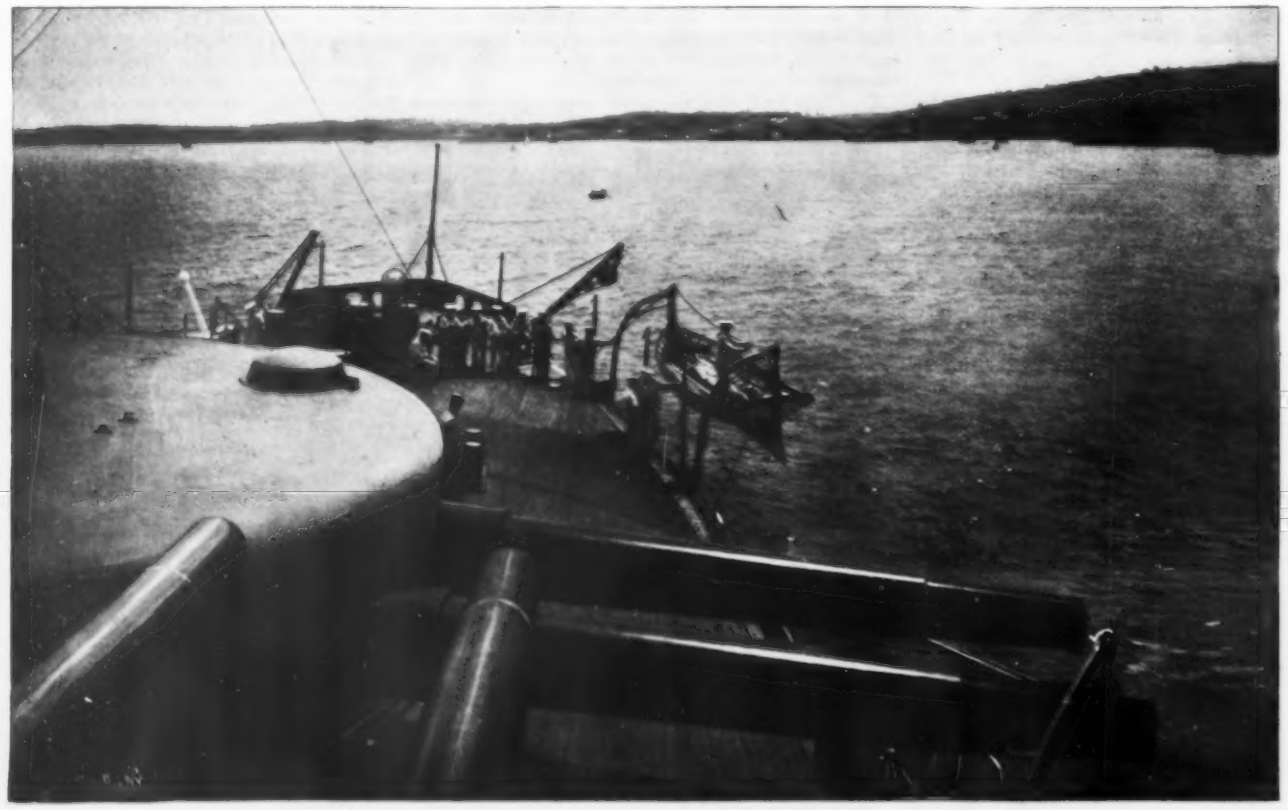
Peering over the main turret are seen the four forward 8-inch rifles, placed in pairs in two turrets, one on each side of the ship. The turrets are of 8-inch steel and revolve within barbettes of 10-inch steel, the offset in the outer wall, seen clearly in the illustration, showing the top edge of the barbette. Armored ammunition tubes pass from the barbettes down to the 2¾-inch steel deck before mentioned, for the passage of the powder and shell. Upon the main deck, and under and slightly to the rear of each 8-inch turret, is a 6-inch gun, which is arranged to deliver broadside and dead ahead fire.

If we take our stand at the stern and look forward, we see the same arrangement of turrets and guns; so that, with the exception of the pilot house, conning tower and mast, the after half of the ship above the main deck is a duplicate of the forward half.

To the rear of the forward 13-inch turret, and forming the base of the military mast, is the conning tower, which is plated with 12 inches of steel. Here the commander will take up his position when going into battle, and through the narrow horizontal slots (to be seen just above the sighting hood of the forward turret) he will watch the enemy. Inside the conning tower is an elaborate arrangement of telephones, electric calls and speaking tubes, by which he can communicate with the engine rooms, the various gun stations and the steering room at the after end of the ship. This latter is situated for protection below the water line and beneath the shelter of the protective deck. When the ship goes into action, one man, snugly ensconced within this little steel cage, can lay his hand upon any part of the ship, controlling her speed, turning her right or left at will and concentrating her guns upon any weak spot in the enemy. Above the conning tower is the pilot house, from which the navigation of the ship is carried on except in the actual time of battle.

Upon the roof of the pilot house, one on each side of the mast, are two 100,000 c. p. search lights, and on the small platform, just above them, are the two controllers, by means of which the beam of light may be raised or lowered and made to sweep the full circle of the ship. On the same platform is one of the range finders, by which the distance of the enemy can be very accurately determined. A similar pair of search lights and a range finder are located on the over deck, above the after end of the bridge deck. One of our illustrations shows the after port search light and one of the 6-pounder guns.

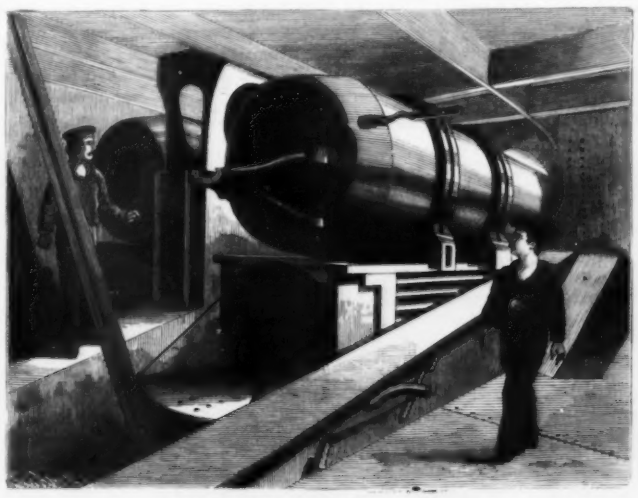
If the visitor descends to the berth deck and walks to the extreme forward end of the ship, he will find himself in the bow torpedo room, page 5. Immediately in front of him he will see the fixed launching-



"INDIANA"—VIEW FROM TOP OF 8-INCH GUN TURRET, LOOKING FORWARD.

tube, which is built into the framework of the ship, parallel to its axis, and is inclined slightly downward to the water. Its outer end is closed with a cover plate shown in the view, page 1, above the water line at the bow. Suspended from the ceiling are the 18-inch Whitehead torpedoes. When they are to be fired they are picked up by the chain hoists, run along the overhead tracks and lowered into the tube. The breech is then closed and the torpedo is discharged, either by compressed air or by a small powder charge.

The torpedo, which weighs 835 pounds, contains three compartments. In the first is the charge of guncotton, which is fired by contact when the torpedo strikes the mark; the second is charged with air at 1,300 pounds to the square inch pressure; and the third contains the little compressed air engines, which work the screw propellers. It is provided with horizontal rudders, by which it can be made to run at any desired depth. The act of discharging the torpedo starts the engines, and they will drive it for 400 yards at 30 knots or for 800 yards at 27 knots an hour. There is another fixed torpedo tube at the stern, and on each broadside there are two movable tubes—as shown in the smaller cut—which are fitted to the side of the ship with a ball and socket joint, and are capable of being trained on an object in the same way as the guns. The space between the main turrets is occupied by the superstructure deck and the bridge deck, upon the latter of which are stowed the lifeboats, gigs and steam pinnaces. On each side of the ship a powerful steam crane is provided, with sufficient reach to enable it to pick up a boat from the water, lift it 35 feet into the air, swing it round and lower it into position on the bridge deck. It is operated by a man who stands on a platform attached to the crane, where, by means of levers, he can control the various motions of lifting and turning.



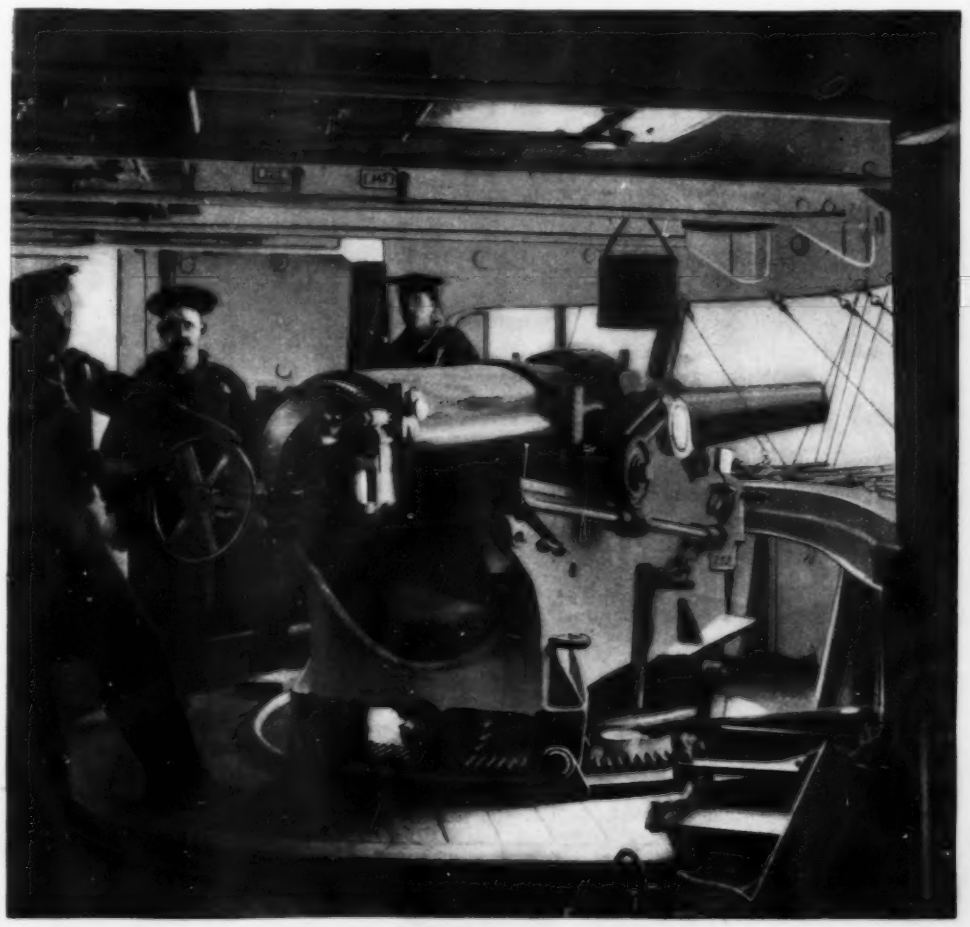
BREECH OF THE 13 INCH GUNS.

A battleship, as we have already shown, is essentially a fighting machine, and when the designer has given her sufficient structural and armored protection to enable her to take her place in the first line of battle, his next object is to arm her with as many armor-piercing and rapid-fire guns as the limits of her displacement will allow. Judged by this double standard, the "Indiana" is without a rival; for it is a fact which has never been disputed that she carries the heaviest armament of any ship afloat to-day. This preponderance of power is due to the eight 8-inch guns which are carried in four turrets flanking the two turrets of the 13-inch guns. They are an entirely novel feature in battleship design, and may be called the chief distinctive feature of this ship. The accepted type of battleship carries usually a main battery of four heavy guns disposed in two turrets, fore and aft, supplemented by a broadside secondary battery of 5 or 6-inch guns, the first being capable of piercing armor and the latter being used against the lightly armored or unarmored portions of the enemy. Thus the "Camperdown," of the British navy, a ship of the same size as the "Indiana," and less effectively protected, carries four 67-ton guns of about the same power as the heavy guns of the American ship and a secondary battery of six 6-inch guns. Against this the "Indiana" carries, in addition to her main and secondary batteries, the eight 8-inch armor-piercing guns above mentioned—a preponderance of power which should give her the victory in a naval duel.

Our illustrations show the various elements which go to make up the armament of the "Indiana," and the methods of mounting and handling the great guns. This, especially in the case of the 13-inch guns, each of which weighs 67 tons, is a matter calling for great skill in design and workmanship: and so well has it been carried out that one man is able to raise or lower these great masses of metal, and swing them through an arc of 270°, by the manipulation of a few small handwheels and levers situated within the sighting station of the turret. The gun itself is mounted in a gun metal seating, to which it is strapped down by the four steel bands shown in the accompanying illustration. The seating is arranged to slide in much the same way as the rest of a lathe upon its bed, upon the upper flanges of a massive steel frame, the forward end of which is hinged to the wall of the turret, the after end being carried by the plunger of a hydraulic ram, by means of which the gun with its carriage is raised or lowered to give the proper elevation. The guns are trained by turning the turret which carries them. This is effected by hydraulic engines located within the shelter of the barbettes, below the turret, operating a pinion, which engages a circular vertical rack bolted to the inside of the turret. To check the recoil of the guns, which represents an initial energy of over 36,000 foot tons, a recoil cylinder is mounted within the gun carriage beneath the gun. It is filled with water, and is provided with a relief valve, which is automatically opened on the discharge of the gun. The plunger or piston is attached to the seating of the gun, and as the gun recoils the water is forced through the valve, the brake action being secured by the small size of the discharge valve. After being loaded the gun is run out to the firing position by admitting water under pressure at the back of the piston in the recoil cylinders.

In describing the process of loading and firing a 13-inch gun, it is necessary to descend below the steel protective deck to the "handling room," shown in the second illustration, page 5, which is located immediately beneath the turret. It is square in form, and at each corner is a watertight door which leads to the ammunition rooms, where the powder and shell are stored in suitable racks. The charge is transferred to a cradle suspended from an overhead track and run out into the handling room, where it is unloaded into the ammunition hoists, of which there are two, one to each gun. Each hoist consists of a triple cage of three hollow cylinders, the upper two for the powder, which is done up in two sections, and the lower for the shell. The two sections of powder weigh 550 pounds and the shell 1,100 pounds.

The cage is then run up to the breech of the gun by a hydraulic ram and steel wire ropes and pulleys, the speed of the hoist being six times that of the ram. When the shell is opposite the breech it is rammed into the gun by a telescopic hydraulic rammer, which can be seen in the first illustration, page 5, pivoted against the turret to the rear of the gun, the rammer being swung back against the turret wall when not in use. The two sections of powder are then rammed in after the shot, the breech plug, which is shown swung to the left clear of the gun, is thrust into the breech and locked, the firing attachment is screwed onto the stud, shown in the same illustration, within the plug, and the gun is ready for the gunner to lay and fire. The breech plug and the mechanism for opening and closing it are very ingeniously designed, and will bear a detailed description. To enable the plug to withstand the shock of discharge, which is as great against the plug as it is against the shell, it is provided with a powerful thread and screwed into the breech of the gun. After the thread has been cut in the lathe, three wide channels are cut across it, parallel to the axis of the plug, similar channels being cut across the thread in the breech. When the plug is inserted, it is placed so that the remaining thread on both plug and breech will enter the corresponding channels. After it is driven home the plug is given one-sixth of a turn, thereby bringing the threads into engagement and locking the breech. There is a great variety of breech mechanisms employed in different navies, and some of them are extremely complicated. The system in use on the "Indiana" is a recent design and a great advance upon previous methods. The three operations of unlocking the plug, withdrawing it upon the swinging tray, and throwing the tray round clear of the breech are performed by one man, by means of a crank shown on the right side of the gun. The first motions of the crank turn a gear which engages a rack on the periphery of the plug and gives it a one-sixth turn, thereby disengaging the threads; the crank shaft then operates a screw, which thrusts the plug out upon the tray; and when this operation is complete another gear is engaged which swings the tray upon its hinges.



"INDIANA"—TRAINING A 6-INCH GUN.

In the illustration, page 7, showing the breech of the 13-inch guns, will be noticed a ladder leading up to a plated, boxlike structure. This latter is the position occupied by the officer who lays and fires the guns. The top of the compartment projects above the roof of the turret, and is heavily armored. It is provided with two narrow vertical and horizontal slots at which two sighting telescopes are placed, one for each gun, as shown on page 4. The axis of each telescope is parallel to the axis of the gun which it represents, and the handwheels which operate the telescopes at the same time serve to work the hydraulic rams for raising and lowering the guns, so that the two are adjusted simultaneously. The turning gear of the turret is set in motion by means of the vertical wheel shown in front of the gunner. When the sights coincide with the object, the gun is fired by means of an electric button placed conveniently to hand.

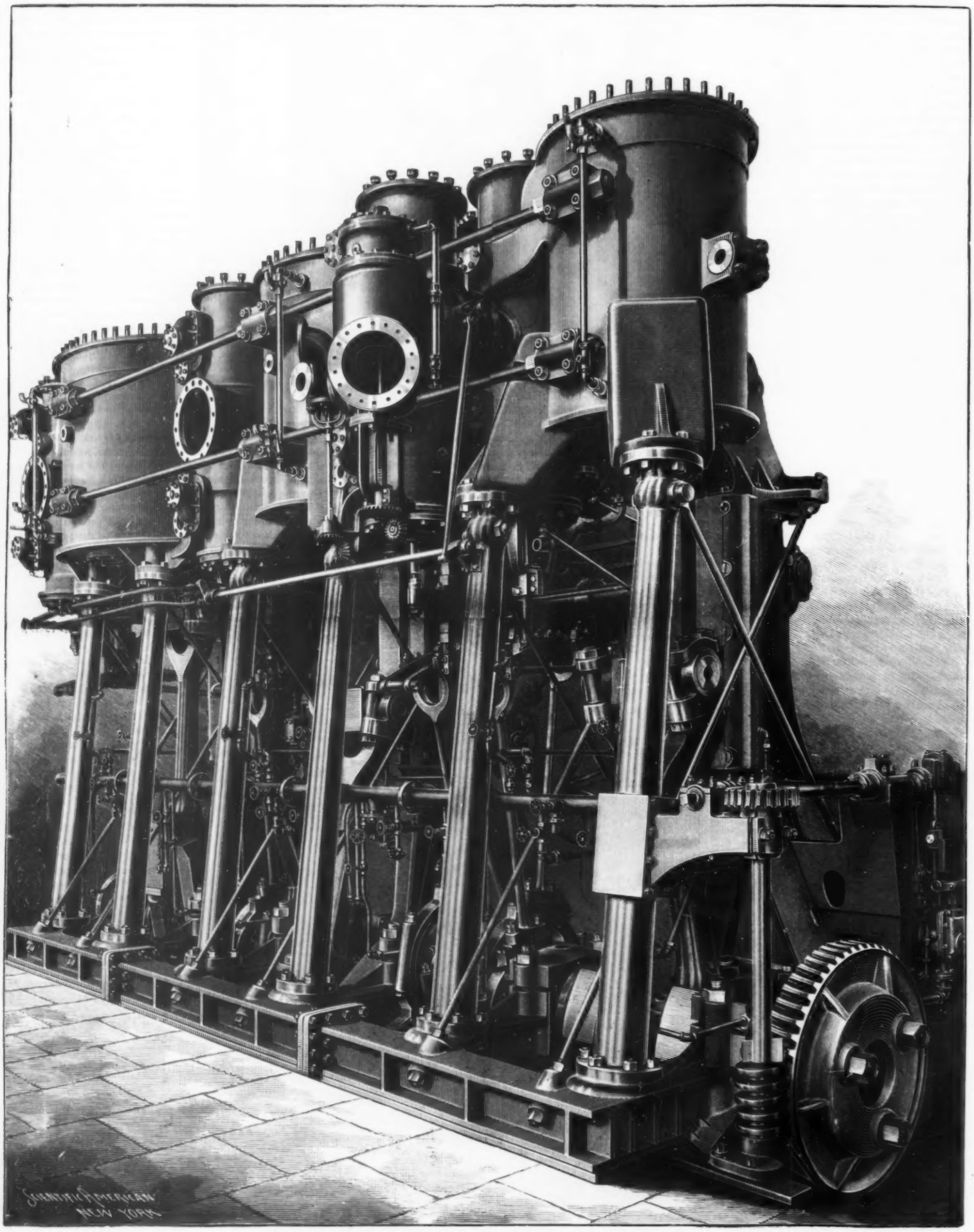
Flanking the main turrets are the four 8-inch gun turrets, whose interior arrangements are very simi-

lar to those above described. These guns are carried at a great height above water—no less than 26 feet—and they would, therefore, be well out of reach of the heavier seas in stormy weather. This great command is a valuable feature in a sea fight—command in a gun being like length of reach in a boxer. The shell being delivered from so great a height would have a "plunging" effect, and would also be less liable to be deflected by striking the tops of the waves. The four 6 inch guns, page 7, are mounted below the 8-inch gun turrets, and on the main deck. The training is effected by means of a pinion and a circular rack, laid on the deck, both of which can be seen in the accompanying illustration. The elevation of the gun is accomplished by the worm and pinion, which meshes into a vertical circular rack, which can be seen attached to the gun.

The last illustration on page 6 shows a part of the broadside rapid-fire 6-pounder battery and the hinged grated shelves on which the gunners stand, the shelves hanging down vertically when not in use. There are twenty of these effective little guns in all. They fire a 2¼-inch shell which is capable of penetrating over 3 inches of iron at a distance of 1,000 yards, and as each can deliver some twenty shots a minute, it can be seen that a torpedo boat would be roughly handled, and probably disabled, long before she could get near enough to discharge her torpedoes. There are also six 1-pounder guns placed in the tops and on the superstructure. The weight, penetration, etc., of the guns is as follows:

Caliber	13-inch.	8-inch.	6-inch.	6-pounder	1-pounder
Length	40 feet	25½ feet	21¼ feet	8 feet	8½ feet
Weight	135,000 lb.	29,300 lb.	13,440 lb.	800 lb.	79 lb.
Perforation of wrgt. iron at muzzle	34·6 in.	20·6 in.	15·6 in.	4·4 in.	2 in.
Velocity at muzzle	2,100 f. s.	2,080 f. s.	2,150 f. s.	1,940 f. s.	1,460 f. s.
Weight of shell	1,100 lb.	250 lb.	100 lb.	6 lb.	1 lb.
Weight of charge	550 lb.	115 lb.	50 lb.	2 lb.	.....

In concluding our description of the armament of the "Indiana," it is gratifying to be able to state that



ONE OF THE TWIN ENGINES OF THE BATTLESHIP "MASSACHUSETTS."

the men behind her guns are excellent marksmen. Word has recently come from Key West that in target practice two shots from a 13-inch gun were placed in succession through the same hole, and that it is a common thing for the target to be knocked to pieces at a range of several thousand yards.

FIRST-CLASS BATTLESHIP "MASSACHUSETTS."

The first-class battleship "Massachusetts," like her sister ship the "Indiana," was launched at the famous shipyard of the Cramp Shipbuilding Company, Philadelphia. The two ships are identical except in a few minor particulars, the "Massachusetts" carrying three torpedo tubes, as against two on the sister ship, and her speed being about three-quarters of a knot greater.

The "Indiana" has been so fully described as regards her construction, armor, guns and operation, that it would be superfluous to repeat the particulars. We shall, therefore, confine the present article to a description of the motive power. The handsome twin triple-expansion engines, one of which is shown in the large engraving, page 8, were built by the Cramp Company from designs furnished by Chief Engineer George W. Melville. Before entering into a detailed description of these very successful designs, mention should be made of the important part which Mr. Melville and his highly efficient staff have played in the upbuilding of our steam navy. In no case, as far as we know, have the creations of this bureau failed to indicate a horse power in excess of the contract requirements, and in many cases the excess has been surprisingly large. Although this result has been directly due to the skill of the contractors, too much credit can scarcely be given to the Bureau of Steam Engineering for the part it has played in securing such gratifying results.

The handsome engraving to which we have referred was made from a photograph of one of the twin main engines of the "Massachusetts," as they stood completed in the erecting shop at the Cramps' shipyard. There are two vertical, direct acting, triple-expansion engines placed in separate watertight compartments, the engines being built exactly in duplicate. The cylinders are carried by inverted cast steel Y frames on one side and by hollow forged steel cylindrical columns on the other, which are bolted to a cast steel bed plate and strongly sway-braced. The high pressure cylinders are fitted with working liners, and the intermediate and low pressure cylinders are steam jacketed on the sides and bottom. The diameter of the high pressure cylinder is 34½ inches, of the intermediate 48 inches, and of the low pressure cylinder 75 inches, the common stroke being 42 inches.

The pistons are dished steel castings, and the piston rods, 7 inches in diameter, are of forged steel, as are also the connecting rods, which are 6⅝ inches diameter at the upper end and 8½ inches diameter at the lower end. The crossheads are of forged steel and they are provided with manganese bronze slippers faced with white metal. The eccentrics are of cast iron, the straps of composition and the rods of forged steel. The steam reversing engine, with 14-inch by 20-inch cylinder, is connected to an arm on the reversing shaft, and the hand reversing gear, consisting of wheel, worm shaft, pinion and rack, is also connected to an arm on the reversing shaft. At the forward end of the main engine will be noticed the engine for turning over the main shaft. It is attached to the frame of the high pressure cylinder and has a pair of cylinders 7 inches diameter by 7 inches stroke. It turns a worm on its main shaft, which in turn operates a vertical worm shaft gearing to a large worm wheel on the shaft of the main engine as shown.

There are two main condensers in which the circulating water passes through the tubes, the total cooling surface being 12,710 square feet, and in each engine room there is a Wheeler condenser connected with the auxiliary exhaust pipes. Each main engine is supplied with a Blake double vertical single acting air pump in which the steam cylinders are placed directly over the pump cylinders, the pump and piston rods being in one length. For each condenser there is a double inlet centrifugal circulating pump which draws from the sea, bilge and main drain-pipe and may discharge into the condenser or overboard. These pumps have each a capacity of 9,000 gallons per minute. They are driven by single cylinder, horizontal engines with cylinders of 6-inch stroke and 12-inch diameter.

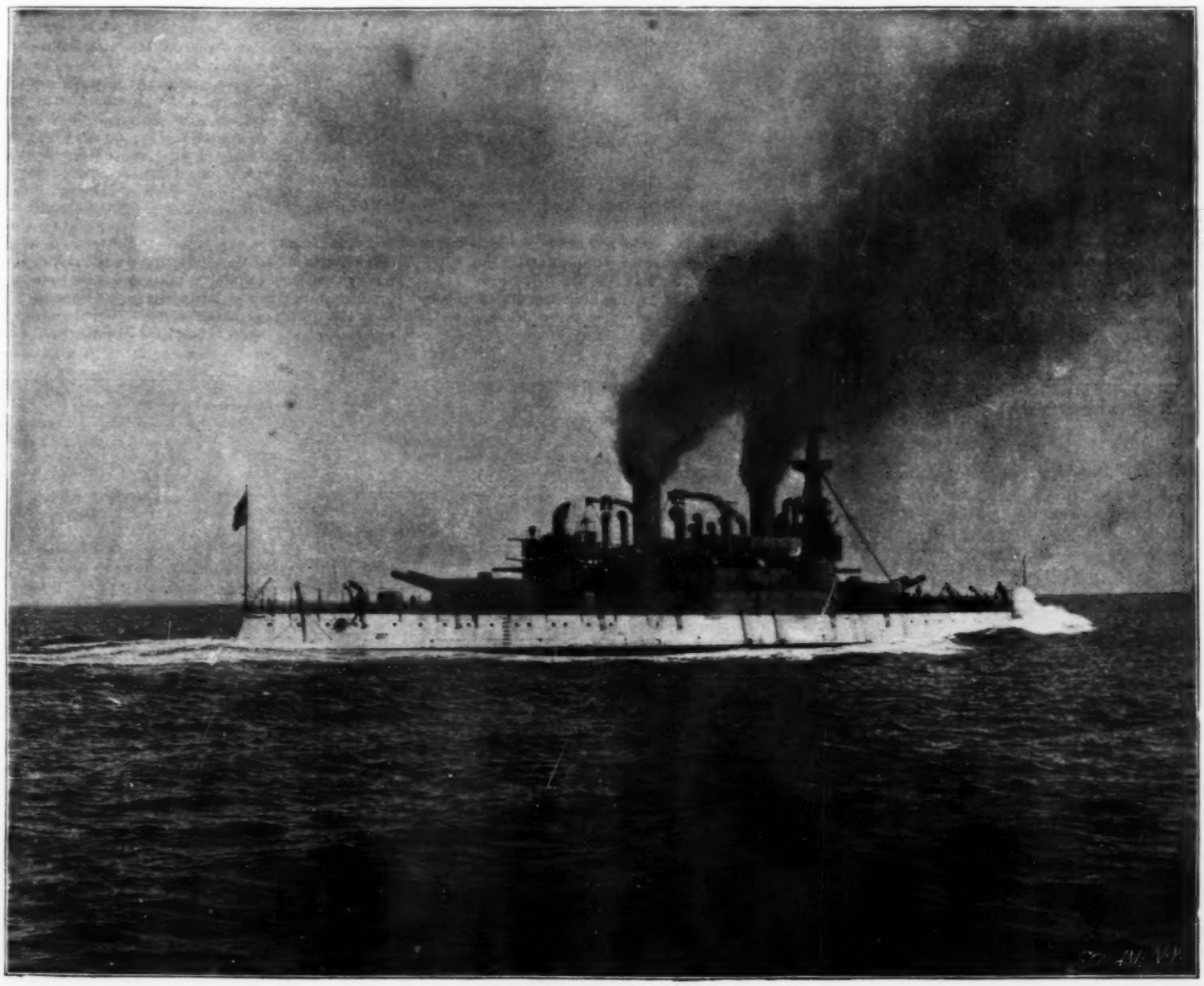
The shafting is hollow and of forged steel. The line shafting is in two sections and is supported on three bearings. The propeller shafts are fitted with a composition casing from just inboard the stern tube shafting box to the propellers. The thrust bearings are of cast iron and are of the horseshoe pattern.

The propellers are of manganese bronze and are three bladed. The pitch is variable, from 14 feet 3 inches to 16 feet 3 inches. The bosses are secured to the shaft by a feather key and a steel nut which is screwed on and locked in place.

There are six steel boilers, four double-ended main and two single-ended auxiliary, all of the horizontal fire tube type. The former have eight and the latter two corrugated furnaces. The longitudinal joints are treble riveted, with double butt straps. The joints on the circumference are lapped and treble riveted. The furnaces are fitted with Cone's patent shaking grate bars. The steam pressure is 160 pounds. The shell plating of the main boilers is 1⅛ inches thick; the diameter is 15 feet and the length 18 feet. The tubes are 2½ inches outside diameter and their total heating surface is 3,647·5 square feet, the total heating surface of each boiler being 4,310 feet. The closed stokehold system of forced draught is employed, and air is supplied by ten Sturtevant blowers.

The work that has to be done by the boilers is understood when it is borne in mind that, in addition to supplying the main engines of over 10,000 horse power, they must supply steam for 86 auxiliary engines, or a total of 158 cylinders.

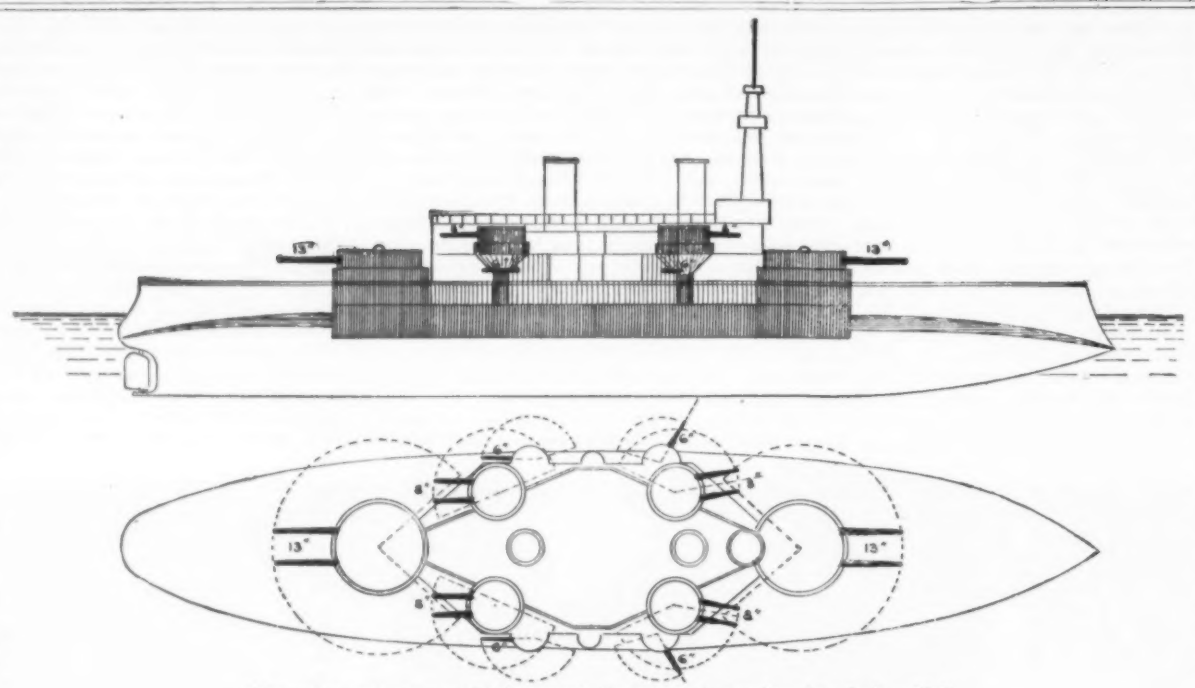
The official trial consisted of two runs in opposite directions, over a measured distance of 31 miles, with a smooth sea and generally favorable conditions. The draught of the "Massachusetts" was 23·79 feet forward and 24·38 feet aft, and her displacement 10,265 tons. The average speed was 16·21 knots. The re-



FIRST-CLASS BATTLESHIP "MASSACHUSETTS."

(Photographed at her fastest trial speed.)

Displacement, 10,288 tons. **Speed,** 16·2 knots. **Maximum Coal Supply,** 1,597 tons. **Complement,** 473. **Armor:** Belt, 18 in.; deck, 2¾ in.; barbettes, 17 in.; turrets, 15 in: casements, 6 in. **Guns:** Main battery, four 13-in., eight 8-in., four 6-in. slow-fire; secondary battery, twenty 6-pounders, four 1-pounders, four Gatlings, two field guns. **Torpedo tubes,** three. **Authorized** 1890.



(Aft guns show maximum fire as originally proposed. Forward guns show maximum fire as finally modified.)

SIDE VIEW AND DECK PLAN OF THE "INDIANA," "MASSACHUSETTS" AND "OREGON."

volutions per minute were for the starboard engine 132·3 and for the port engine 133·06. The boiler pressure was 163 pounds and the pressure at the engines 155·6 pounds. The total indicated horse power was 10,402·6, and a maximum horse power of 11,440 was indicated during fifteen minutes of the run to the south.

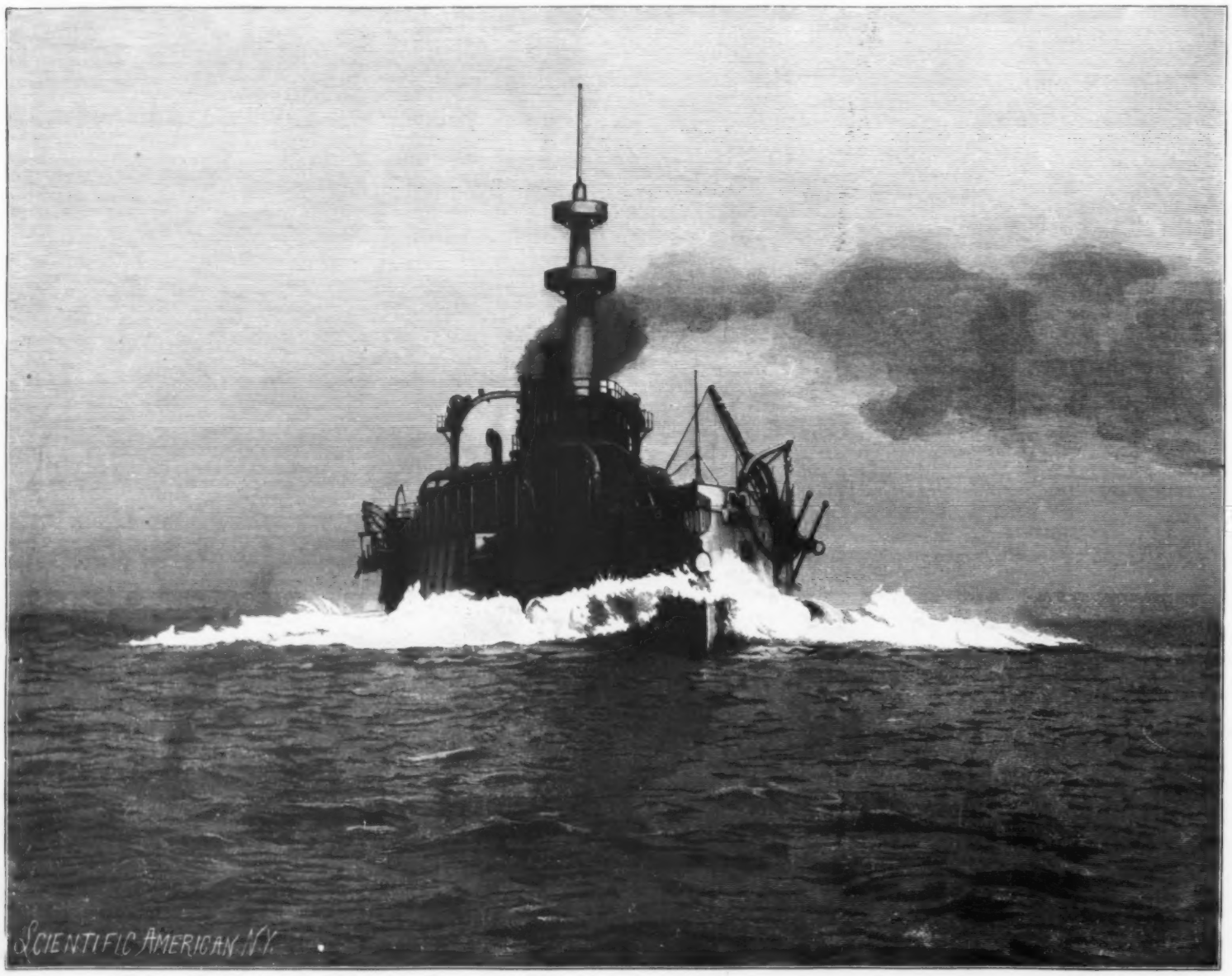
The boilers gave great satisfaction and there was no tendency to prime. The main engine ran without any heating of consequence, and it was necessary to use but little water. A careful examination was made of boilers and engines after the trial and all parts were found to be in excellent condition.

We are informed by Mr. George W. Melville, engineer-in-chief of the navy, that circumstances prevented the carrying out of a trial for coal consumption of sufficient length to give reliable data.

FIRST-CLASS BATTLESHIP "OREGON."

The distinction of having built the first of the first-class battleships of our new navy belongs to two firms—the Cramp Shipbuilding Company, of Philadelphia, who constructed the "Indiana" and the "Massachusetts," and the Union Iron Works, of San Francisco, the builders of the "Oregon." The Eastern-built ships are identical as to design, and the "Oregon" varies from them only in a few insignificant details.

The Union Iron Works have played an important part in the creation of our modern navy, and considering the difficulties under which they labored in being so far removed from the great centers of the iron and steel industries, it is greatly to the credit of this enterprising firm that the ships turned out from its yards have shown such a uniform excellence. Like those of its great Eastern rivals at Philadelphia, its warships have shown a gratifying excess of speed over contract requirements, the most notable case being that of the



FIRST-CLASS BATTLESHIP "OREGON."

(Photographed at full speed.)

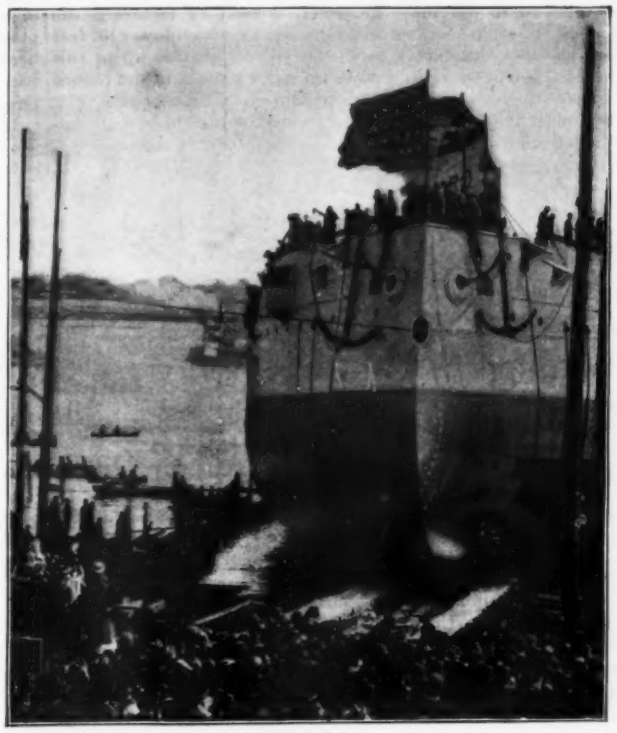
Displacement, 10,288 tons. **Speed**, 16·8 knots. **Maximum Coal Supply**, 1,594 tons. **Complement**, 473. **Armor:** Belt, 18 in.; deck, 2¾ in.; barbettes, 17 in.; turrets, 15 in.; casements, 6 in. **Guns:** Main battery, four 13-in.; eight 8 in.; four slow-fire 6-in.; secondary rapid-fire battery, twenty 6-pounders; six 1-pounders; four Gatlings; two field guns. **Torpedo tubes**, three. **Authorized** 1890.

protected cruiser "Olympia," which steamed 21·69 knots, as against the contract speed of 20 knots—a feat which, on the basis of $50,000 for every quarter knot excess, brought to the builders the handsome bonus of $300,000. This bonus, it may be mentioned, was exceeded in the case of the "Columbia" and "Minneapolis," built at the Cramps' yard, the former winning $350,000 and the latter $414,600 for the contractors.

We have given such a full description of the sister ships "Indiana" and "Massachusetts" (see pages 1 to 10) that it is unnecessary to reiterate the details in connection with the "Oregon."

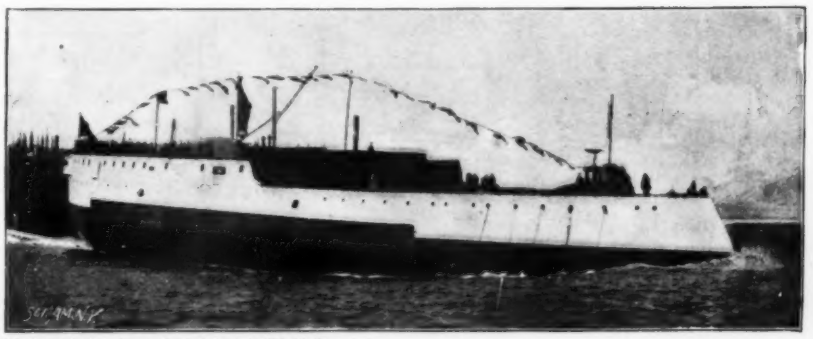
The contract speed of the "Oregon" was 15 knots per hour and the estimated horse power of the engines 9,000. For every quarter knot by which she exceeded the contract speed the builders were to receive a bonus of $25,000, and for every quarter knot by which she fell below the contract a penalty of $25,000 was to be paid. On her trial she maintained an average of 16·79 knots, the engines indicating 11,111 horse power, or 2,111 in excess of the estimate.

Our illustration of the ship, page 10, is reproduced from a photograph which was obtained during her trial trip under novel and hazardous circumstances. On account of the wide beam and somewhat bluff bows of a battleship, it rolls up a great bow wave when the engines are pushing the ship, as in this case, beyond the speed for which it was designed; and it occurred to an enterprising Californian photographer, Mr. O. V. Lange, that the great onrushing ship with its bows smothered in a mass of boiling water would be a good subject for the camera. Arrangements were quietly made with the captain of a little tug to shoot across the "Oregon's" bow as she came on at full speed, a plan of which the "Oregon's" commander had no knowledge. The vessels were almost together, and it was too late for the great ship to swerve either way, when the tug was seen moving directly across the course of the battleship, at whose stem a foaming wave was piled at times 12 feet high and spreading far on either side. The tug could not turn back, as the bow of the "Oregon" seemed about to bear directly down upon her, and there was consternation aboard the little vessel. The photographer says: "The 'Oregon' seemed to be coming like a cannon ball, but I determined to get that picture if it was my last. I steadied my nerves a moment, glanced into the finder, and clicked the shutter. Then, with the camera under one arm, I ran to a stanchion and grasped it. The next moment there was a noise of rushing water and a violent whirling and pitching of the tug," which, it was said, had escaped collision by the fraction of a second, the ship's side flashing by within 10 feet.



Photographed and copyrighted, 1896, by W. H. Rau.

LAUNCHING OF THE "IOWA."



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THE "IOWA" TAKING THE WATER.

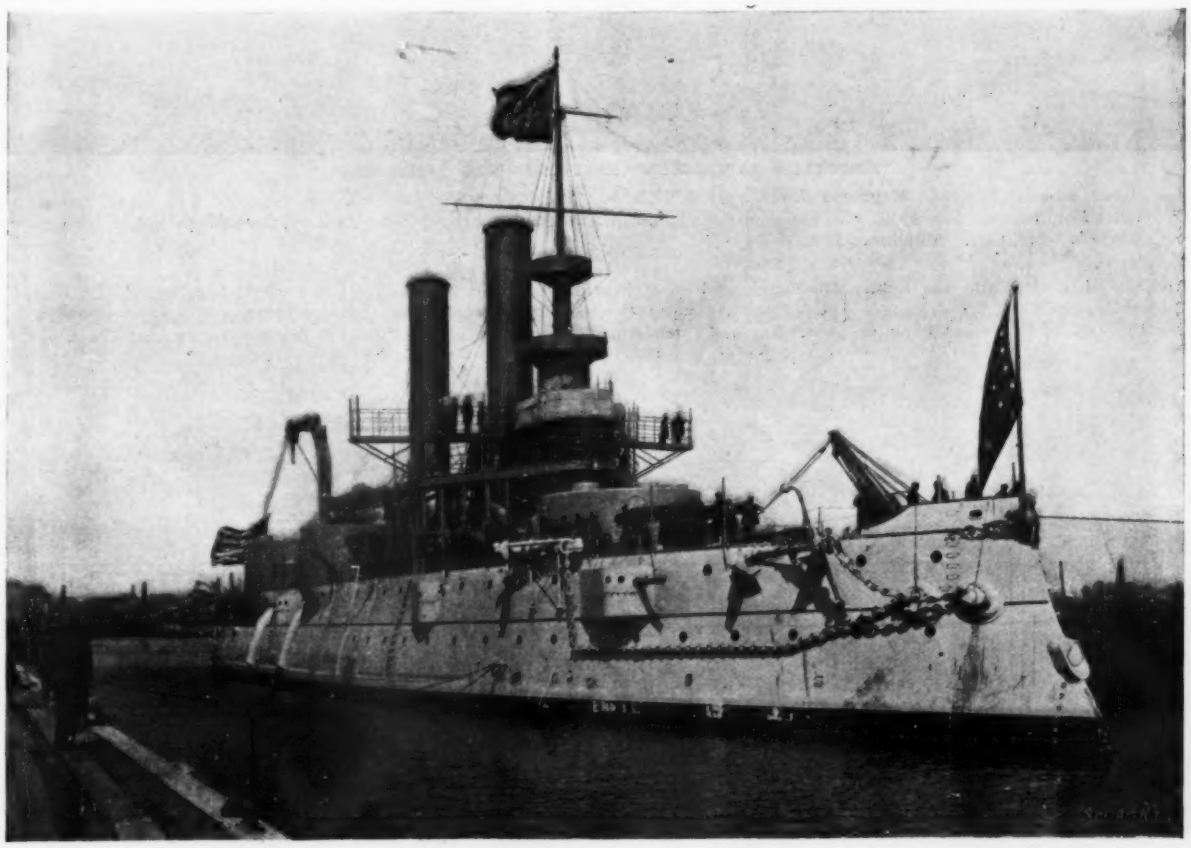
FIRST-CLASS SEA-GOING BATTLESHIP "IOWA."

The "Iowa" has the distinction of being the first modern first-class sea-going battleship built for the United States navy, and she is also the largest and fastest of our fleet of ships of the line.

Our readers will doubtless observe that the "Iowa" bears a general resemblance to the "Massachusetts" and her class, and they will ask why the "Iowa" should be designated as the first modern sea-going battleship of our navy. As a matter of fact, however, the "Indiana," "Massachusetts" and "Oregon" are listed on the naval register as coast defense battleships, and, although they would be capable of crossing the Atlantic and giving a good account of themselves in a fight upon the high seas, they were not specifically designed for such service. Those elements of a battleship which make her a good sea boat in heavy weather have been somewhat sacrificed in these boats in favor of extremely heavy guns and massive armor plates, and it is this concentration of guns and armor which renders the "Massachusetts" and the vessels of her class the most powerful fighting ships in the world.

The design of the "Iowa" is based upon that of the "Massachusetts," but with a view to giving her better sea-going qualities her freeboard has been raised about 8 or 9 feet, or about the height of one deck, from her bow back as far as the rear 8-inch gun turrets. The forward pair of heavy guns with their turrets have been raised to the same extent, the axis of these guns being now about 26 feet above the water line at normal draught, and therefore well out of the reach of the heavy seas which would be liable to roll green water over the same pair of guns in the "Massachusetts" if she were steaming head to sea in heavy weather. The freeboard forward in the "Iowa" is about 20 feet and aft it is about 12 feet. The latter is the greatest freeboard of the "Massachusetts," which has a flush deck fore and aft for the whole length of the vessel.

The "Iowa" is 360 feet long, 72 feet beam, and she has a displacement loaded of 11,410 tons. Three thousand tons of the weight is devoted to armor, which ranges in thickness from 2¾ inches to 15 inches. The protection to the hull and machinery is afforded by a steel belt of 14 inches maximum thickness, covering over 70 per cent of the load line. This belt extends from 4 feet 6 inches below the load line to 3 feet above it. Above this belt to the main deck between the 12-inch gun turrets, a belt of 4-inch armor is worked to cause shell loaded with high explosives to break up before entering the vessel. On top of the 14-inch armor a horizontal deck 2¾ inches thick is worked, and from the ends of the side armor to the extremities of the vessel a similar deck 3 inches in thickness is provided. Above the armor decks, belts of cellulose, to prevent the inrush of water in the event of the vessel being injured, are provided. The hull is built on the cellular system, with inner bottom, and great attention has been given to the subdivision of the vessel into a large number of watertight compartments, each provided with its own means of pumping and draining.



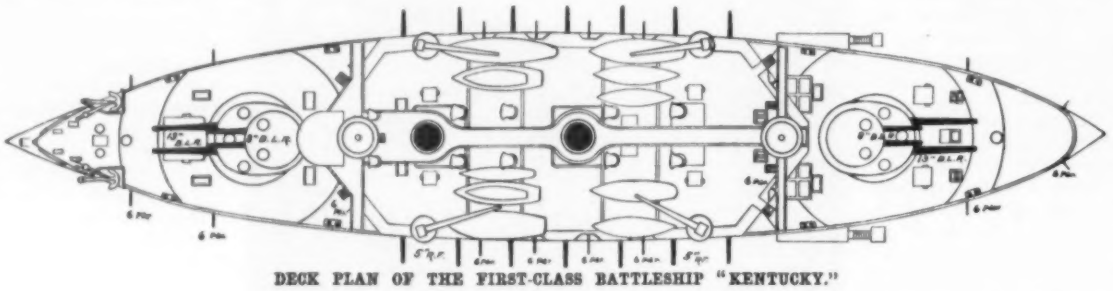
FIRST-CLASS SEA-GOING BATTLESHIP "IOWA."

Displacement, 11,340 tons. **Speed**, 17·1 knots. **Maximum Coal Supply**, 1,795 tons. **Complement**, 505. **Armor:** Belt, 14 in.; deck, 2¾ in.; barbettes, 15 in.; turrets, 15 in.; casements, 6 in. **Guns:** Main battery, four 12-in., eight 8-in., six 4-in. rapid-fire; secondary rapid-fire battery, twenty 6-pounders, four 1-pounders, four Colts, two field guns. **Torpedo tubes**, four. **Authorized** 1892.

The general disposition of the guns and turrets is similar to that of the "Indiana" type. The heaviest guns of the main armament, of 12-inch caliber, are located in two large turrets of 15-inch Harvey steel, which lie on the center line of the ship at each end of the armored citadel. Between the main turrets and well out on the sides of the ship are four smaller turrets, each of which carries two 8-inch rifled guns, which discharge an armor-piercing shell weighing 250 pounds that is capable of penetrating eight inches of steel at a distance of two miles. On the main deck is a battery of eight 4-inch rapid-fire guns which discharge their 33-pound shells with such rapidity that five of them from any one gun can be in the air traveling toward the mark at the same time. In addition to these, the "Iowa" carries in her military tops and on the superstructure deck, and in various commanding positions upon the bridge, twenty 6-pounders, four 1-pounders and four Colts, all of which are rapid firers and could pour a perfect hail of shot and shell upon the shelterless and the lightly protected parts of a hostile ship.

The ship is driven by a set of twin-screw triple expansion engines of 12,105 horse power at a maximum speed of 17·1 knots an hour. With her large bunker capacity of nearly 1,800 tons, she is capable of steaming continuously at a cruising speed of 10 knots for thirty-one consecutive days, in which time she would cover 7,500 knots. The increased size of the ship and the extra accommodation afforded by the spar deck forward allows of the crew being berthed with a greater degree of comfort than is possible in ships of a lower freeboard like the "Indiana." A striking feature is the unusual height of the smokestacks, which tower 100 feet above the grate bars. They were carried up to this height to secure a powerful natural draught and reduce the forced draught air pressure in the stokehold.

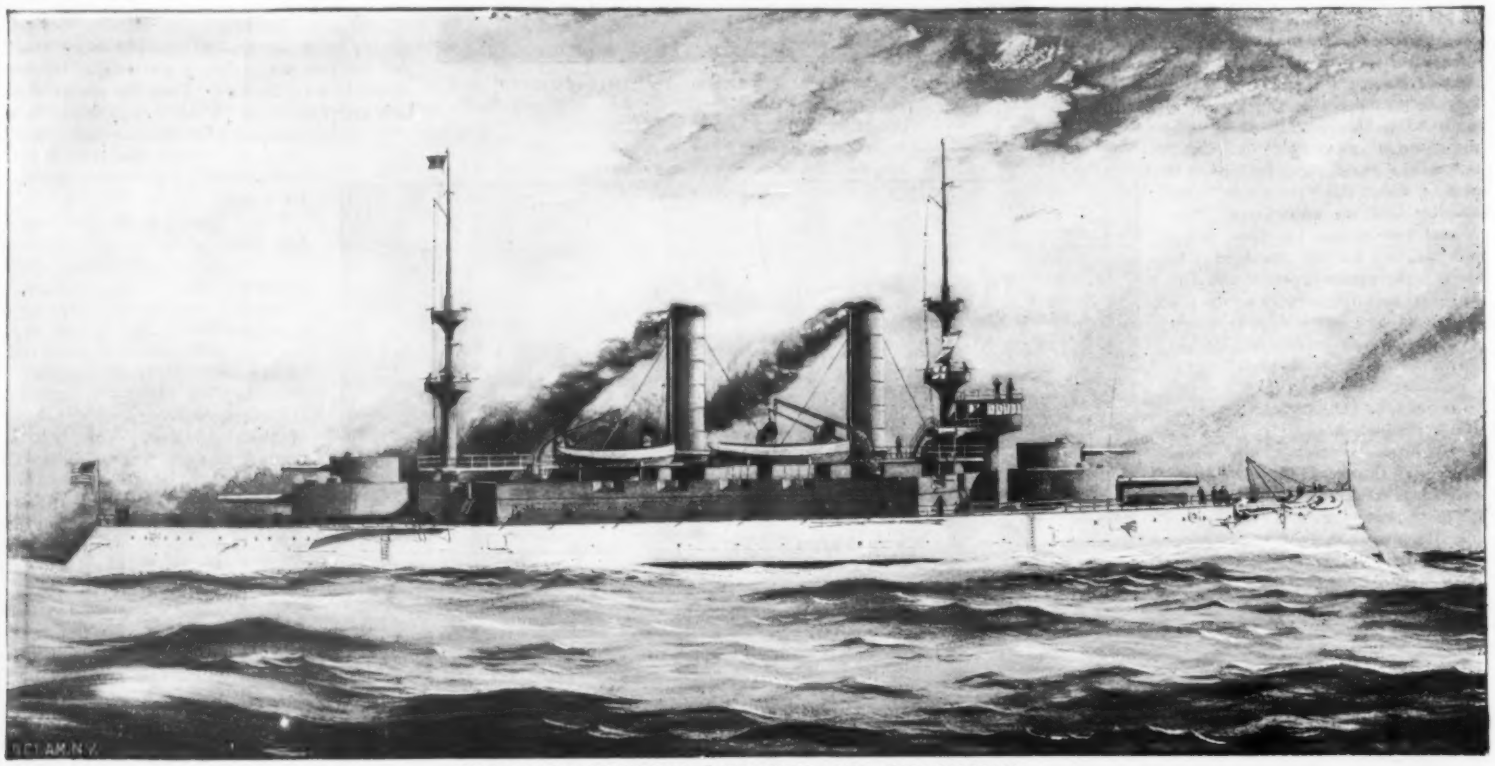
This noble vessel is at present doing duty with Admiral Sampson's fleet of battleships, cruisers and torpedo boats at Key West.



DECK PLAN OF THE FIRST-CLASS BATTLESHIP "KENTUCKY."

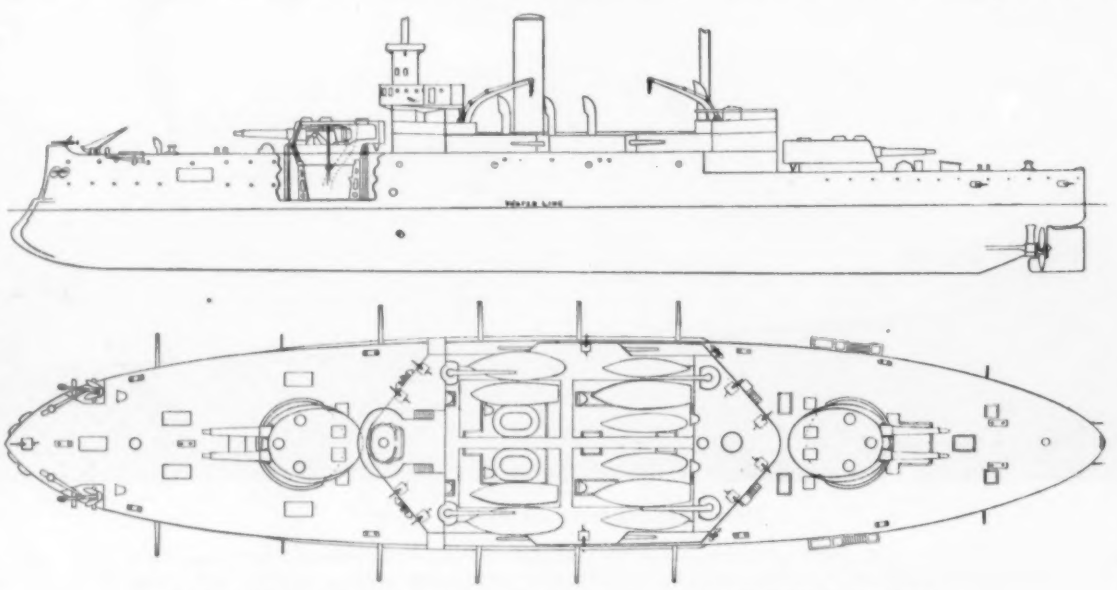
FIRST-CLASS DOUBLE-DECKED-TURRET BATTLESHIP "KENTUCKY."

The designs for that splendid trio the "Indiana," "Massachusetts" and "Oregon" showed a great advance in armor and guns upon anything building or afloat at the time the designs were published. To flank the 13-inch guns of the main battery with eight 8-inch armor-piercing rifles placed within four heavily plated turrets at an elevation of 26 feet above the water line was a departure from existing ideas as daring as it was novel; and European designers expressed a doubt that the ships could ever carry so heavy an armament successfully. The "Indiana" has had her trials and justified the confidence of her designers. Indeed, on every point but one she has more than fulfilled expectations. In the gunnery trials, however, it was found that the arc of training of the 8-inch and 6-inch guns would have to be somewhat reduced on account of interference. In official circles this was not altogether unexpected, as the experience of certain European ships had shown that the effect of the blast of the heavy guns extended over a wider area than had been supposed at the time the designs of the "Indiana" class were drawn up. By reference to the deck plan on page 10, it will be seen that the 8-inch guns were originally intended to fire full ahead or full astern, and also through a considerable arc of training on the opposite beam. To do this latter they had to fire across the top of the 13-inch gun turrets. In the gunnery trials it was found that if the 8-inch guns were laid any nearer to the 13-inch gun turrets than 80 degrees forward of the beam, the effect of the blast was so powerful as to render the sighting hoods of the latter untenable. It was therefore suggested that stops be placed on the turrets to prevent their training any nearer to the axis of the ship than 10 degrees. At the same time the blast of the 13-inch guns, when fired on the maximum train abaft the beam, necessitated the sacrifice of the axial fire of the 6-inch guns. These modifications, which are shown in the diagram, page 10, are not so serious as they



FIRST-CLASS BATTLESHIPS "KENTUCKY" AND "KEARSARGE."

Displacement, 11,525 tons. **Speed**, 16 knots. **Maximum Coal Supply**, 1,210 tons. **Complement**, 511. **Armor:** Belt, 9½ to 16½ in.; deck, 2¾ in.; barbettes, 15 in.; turrets, 17 in. **Guns:** Main battery, four 13-in., four 8-in.; fourteen 5-in. rapid-fire; secondary rapid-fire battery, twenty 6-pounders, six 1-pounders, four Colts, two field guns. **Torpedo tubes**, four. **Authorized** 1895.



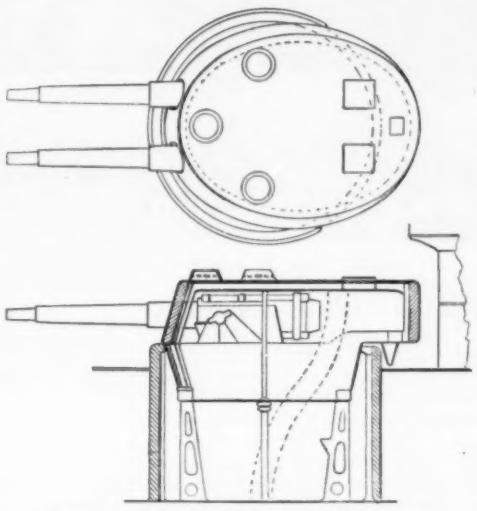
DECK PLAN AND SIDE ELEVATION OF THE FIRST-CLASS BATTLESHIP "ALABAMA."

might at first sight appear, for naval engagements will very seldom be carried out in an end-on position; and for broadside firing the whole of the battery of the "Indiana" is still available. The difficulty of interference was foreseen at the time the plans of the "Kearsarge" were drawn up, and it was overcome with characteristic ingenuity in the following way.

It was decided to dispense with two of the 8-inch turrets altogether, and place the remaining pair upon the main 13-inch turrets, as shown in the accompanying engraving. By this arrangement the remaining four guns of the new design were rendered actually more effective, as far as their arc of training was concerned, than the eight similar guns of the "Indiana." This is evident from a comparison of deck plans of the two types, from which it will be seen that the "Indiana" is incapable of dead ahead or dead astern fire with her 8-inch guns, and that her maximum concentration of fire from the whole eight of them is four on either broadside. The "Kearsarge," on the other hand, can not only concentrate an equal number of 8-inch guns on each broadside, but can swing each pair through an unbroken arc of 270 degrees ahead or astern. Experiments recently carried out at Indian Head on an improvised platform showed that there would be no inconvenience experienced in the 13-inch turrets from the blast of the superposed 8-inch guns.

Moreover, the turning gear and ammunition hoists of the 8-inch guns on the "Kearsarge" have an unparalleled protection afforded to them by the 15-inch armor of the turrets and barbettes upon which they stand, whereas the base of the "Indiana's" 8 inch barbettes is plated with comparatively light armor; and should a shell penetrate and burst within them, it might disable the guns altogether. From these considerations it is evident that the sacrifice of power in removing four of the 8-inch guns is more apparent than real.

ELLIPTICAL TURRET OF THE FIRST-CLASS BATTLESHIP "ALABAMA."

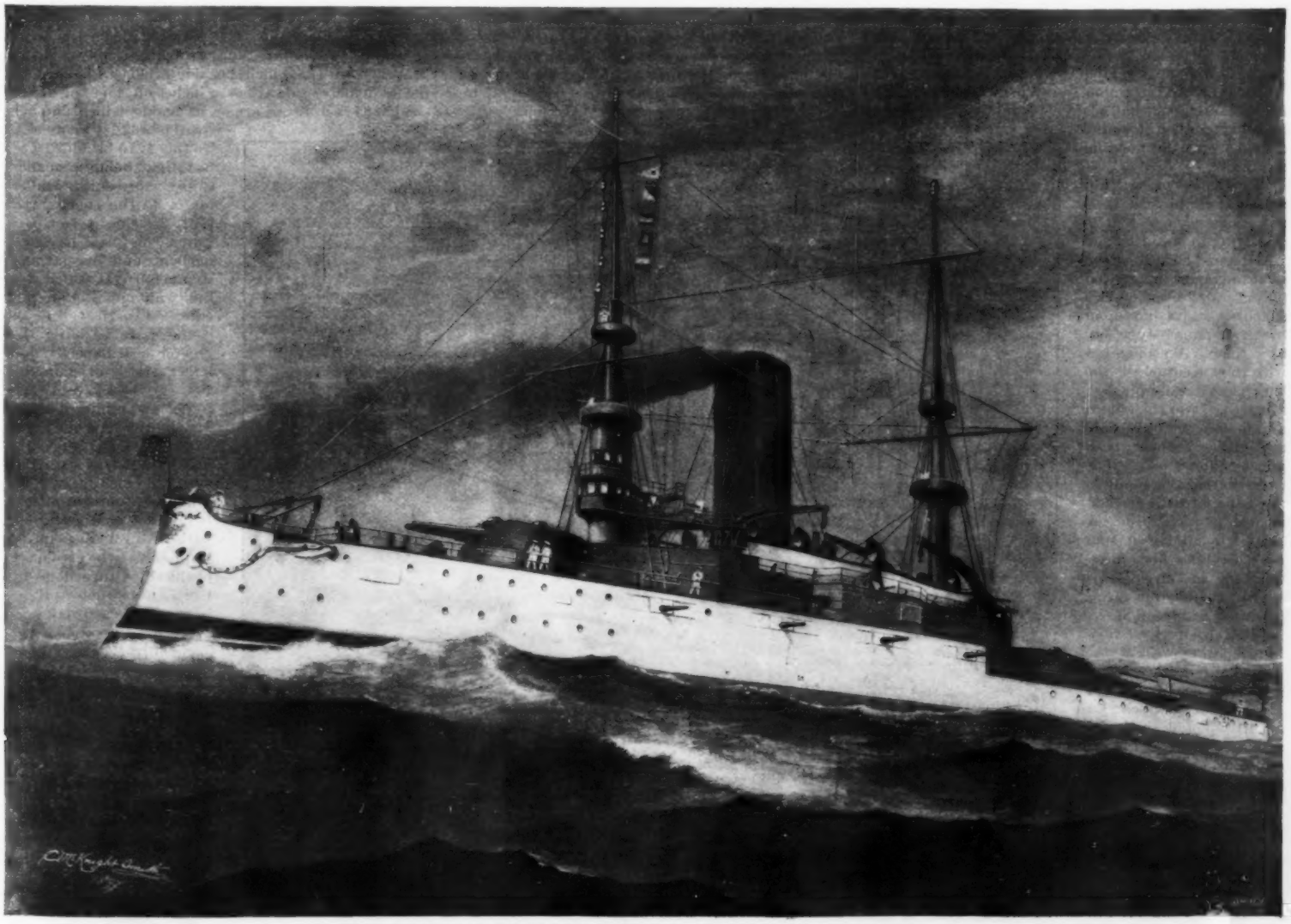


PLAN AND VERTICAL SECTION THROUGH ELLIPTICAL TURRET AND BARBETTE.

At the same time it should be mentioned that in spite of its many and obvious advantages, there are serious objections urged against the double turret by naval experts, the chief of which is that in placing guns on a ship it is a risky policy to put "too many eggs into one basket." It is an accepted axiom in warship design that the various gun stations of a ship should be as widely separated as possible, with a view to localizing the damage inflicted by a successful shot.

If the lower half of a double-deck turret should be crippled, the upper turret would also be placed *hors de combat*, and a light shell which was incapable of penetrating the 15-inch armor of the lower turret might pass through the 9-inch armor of the upper turret and wreck the turning gear below, thereby disabling the four guns. There is a further objection urged by the gunners in the fact that the two sets of guns must be trained together, whereas it might frequently be desirable in the course of a fight to train the 13-inch guns upon one part of the enemy and the lighter guns upon some other part. The whole question, however, was well thrashed out by the experts at the time the ships were designed, and it was considered that the advantages more than offset the objections which were raised against the system.

Next to the turrets the most novel feature in these ships is the powerful broadside battery of fourteen 5-inch rapid-fire guns which it has been possible to substitute for the four 8-inch guns and turrets and the



FIRST-CLASS BATTLESHIPS "ALABAMA," "WISCONSIN" AND "ILLINOIS."

Displacement, 11,525 tons. **Speed**, 16 knots. **Maximum Coal Supply**, 1,200 tons. **Complement**, 489. **Armor**: Belt, 9½ to 16½ in.; deck, 2¾ in.; barbettes, 15 in.; turrets, 17 in. **Guns**: Main battery, four 13-in., fourteen 6-in. rapid-fire; secondary rapid-fire battery, sixteen 6-pounders, four 1-pounders, one Colt, two field guns Torpedo tubes, four. **Authorized** 1896.

four slow-firing 6-inch guns of the "Indiana." This battery is shown in the engravings ranged within a central battery on the main deck between the two turrets. There are seven guns on each broadside, each gun firing through an arc of 90 degrees. Though the shell for the 5-inch gun weighs only 50 pounds as against 250 pounds for the shell of the 8-inch gun, so great is the rapidity of fire from the former gun, that three times the weight of metal will be thrown in a given time from the rapid fire battery. In one minute of a sea-fight one side of this battery alone could pour into the enemy fifty-six shots, or nearly 3,000 pounds of steel, at a velocity of 2,300 feet a second, and with a battering or crushing effect of 102,704 foot tons—a force sufficient to lift the ship itself bodily 9 feet in the air. The subjoined table gives a detailed analysis of the total broadside.

The "Kentucky" and her sister ship, the "Kearsarge," are under construction by the Newport News Shipbuilding Co., of Newport News, Va. They were both launched March 24, 1898, and they are now being rushed to completion in view of the present international crisis.

BROADSIDE DISCHARGE OF THE "KENTUCKY."

Number of Guns.	Diameter in Inches.	Weight in Pounds.	Velocity in Foot-Seconds.	Energy in Foot-Tons.	Total Energy.	Penetration in Inches at Muzzle.	Point of Attack in Enemy.
4	13	1100	2100	33,627	134,508	34·6	Belt and main turrets.
4	8	250	2150	8,011	32,044	21·6	Conning tower and casement armor.
7	5	50	2300	1,834	12,838	13·0	Thin armor, superstructure, and unarmored ends.

FIRST-CLASS BATTLESHIP "ALABAMA."

The "Alabama" is one of three first-class battleships, identical in design, which were authorized June 10, 1896. Of these the "Alabama" is building at Cramps' yard, the "Illinois" at Newport News and the "Wisconsin" at the Union Iron Works, San Francisco. All three are about half completed and, of course, work is being pushed forward on them with all possible speed.

The science of warship design is nothing if it is not progressive, and it is gratifying to note that the "Alabama" class show the same advance upon the "Kentucky" class of 1895 as these ships did upon the "Indiana" type before them. As compared with the "Kentucky" the 8-inch gun has disappeared altogether, and the weight and power of the secondary battery has been greatly increased. Moreover, the seagoing qualities as compared with the former ships have been improved by adding a spar deck for the first three-quarters of the ship's length, thereby increasing the freeboard from 13 feet in the "Kentucky" to 20 feet in the "Alabama." The main battery is the same and consists of four 13-inch guns, which fire an 1,100-pound shell with a muzzle energy of 33,627 foot-tons, equal to the perforation of 34½ inches of wrought iron. The forward pair are carried above the spar deck at an elevation of 26½ feet above the water line. At this great height they could be fought in any weather, even when going head on to a heavy sea, which is probably more than can be said for the forward guns of ships with a freeboard some seven or eight feet lower.

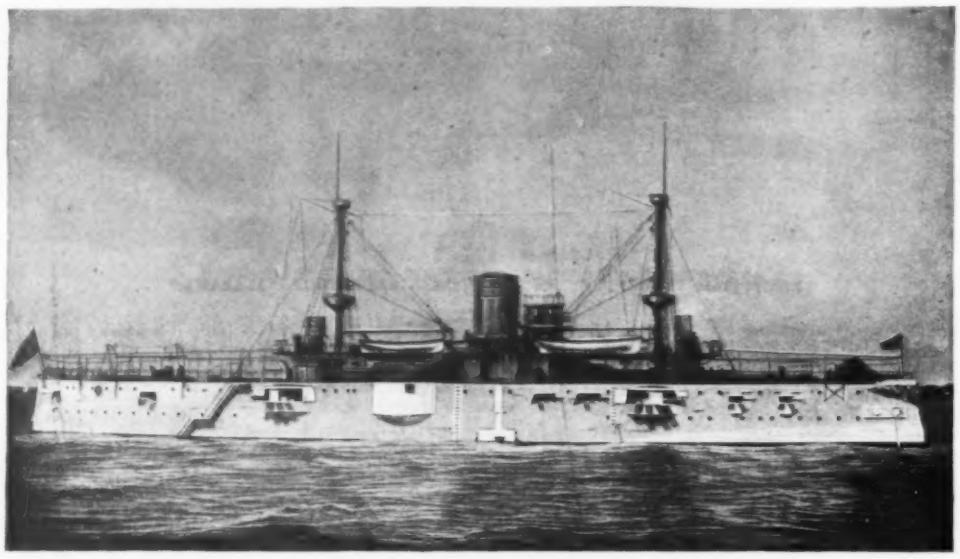
The spar deck extends as far as the after end of the central battery. The after turret is carried above the main deck, or some 7 or 8 feet lower than the forward turret, thereby increasing the stability of the ship. The turrets are of what is known as the elliptical type. They are oval in plan, with the front plates slightly inclined and the rear plates vertical. This form is adopted as being lighter and giving more room for the handling of the guns and their loading appliances. In the old form of circular turret there was more room than was necessary at the sides and too little at the rear of the guns. The diameter of the stationary barbette is made somewhat larger than the shorter axis of the turret, and the center of gravity of the revolving parts is in the axis of rotation: so that the turret, in spite of its considerable overhang at the rear, is balanced and can be turned by its engine without serious retardation, even when the ship has a heavy list. Of the three sighting hoods, the center one is for the man who turns the turret, whose sole work it is to keep the guns always upon the target, as far as their lateral direction is concerned. The hoods on each side are occupied by the "gun pointers," who give the gun the proper elevation or depression.

The removal of the 8-inch guns and turrets has enabled the strength of the secondary battery to be enormously increased, the fourteen 5-inch rapid-fire guns of the "Kentucky" giving place to a battery of fourteen 6-inch rapid-fire guns in the "Alabama." These fire a 100-pound shell, as against the 50-pound shell used by the smaller gun, and their rapidity of fire is only slightly less. Each of these guns will have a muzzle energy of 3,204 tons and will be capable of penetrating 15·6 inches of iron. In addition to its greater weight, the battery will be superior to that of the "Kentucky," because its guns are more widely separated and the protection afforded to the gunners is more complete. Eight of the guns will be inclosed within a central battery on the main deck, whose protection will consist of a continuous wall of 5½ inches of steel. Forward in the bows on the same deck will be two more 6-inch guns, similarly protected, and four other 6-inch guns, two on each side, will be mounted on the spar deck above this casement. The latter will also be protected with 6 inches of steel, and they will be capable of firing dead ahead and dead astern as well as on the broadside. The combined energy of one broadside of the 6-inch battery alone will amount to about 134,568 foot-tons per minute—sufficient, when imparted to bursting shells, to tear the unprotected and lightly protected parts of an enemy's ship to pieces, and quickly turn the gun positions into a mere shambles. To these is added a battery of sixteen 6-pounders and four 1-pounders. There are also four broadside torpedo tubes protected with 6 inches of steel armor.

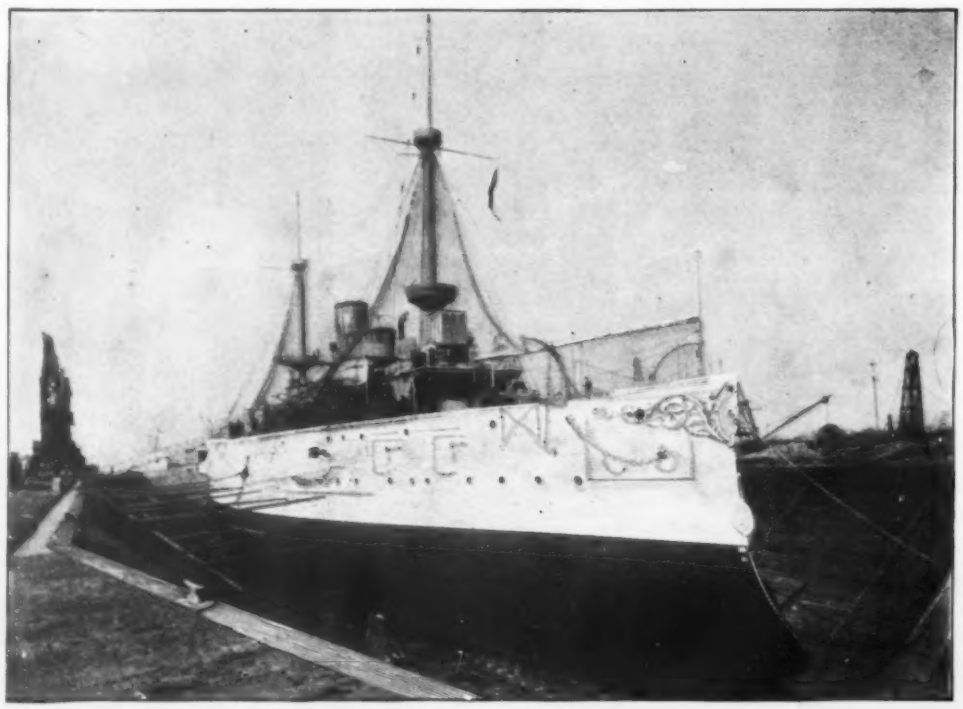
A feature which is a novelty in our navy, though it has been used in many of the later ships abroad, is the placing of the smokestacks abreast of each other instead of on the axis of the ship.

In concluding our notice of these fine ships, it should be pointed out that they maintain the reputation of our naval constructors at the high level at which it was placed by the appearance of the plans of the "Indiana" type some eight years ago. Like them, they carry heavier armor and heavier guns for a given displacement and speed than any ships in the world.

This is best shown by a comparison with the "Majestic" of the British navy. The "Majestic" has a displacement, loaded, of about 15,000 tons to about 11,500 tons for the "Alabama." In spite of this disparity, the "Alabama" carries four 13-inch guns, as against four 12-inch for the "Majestic;" she has fourteen 6-inch rapid-fire guns, as against twelve; she is protected with 16½ inches of side armor, as against 15 inches (9 inches side armor, 4 inches on slopes of deck); she has 17-inch turret armor, as against 6-inch, and her speed is only 1½ knots less. To this is to be added the fact that, being a smaller ship, she presents a smaller target to the enemy, and that, drawing 4 feet less water, she can navigate harbors and rivers and channels into which her bulky antagonist dare not enter. Against this, of course, is to be offset the greater coal capacity and larger stores of ammunition carried by the "Majestic" and rendered necessary by the long distances which the British ships may have to traverse. But even after making such allowances it must be admitted that the above comparison bears eloquent testimony to the excellence of the ships turned out by Chief Constructor Hichborn and his associates.



SECOND-CLASS BATTLESHIP "TEXAS."



SECOND-CLASS BATTLESHIP "TEXAS."

Displacement, 6,315 tons. **Speed**, 17·8 knots. **Maximum Coal Supply**, 850 tons. **Complement**, 389. **Armor:** Belt, 12 in.; deck, 2 in.; turrets, 12 in. **Guns:** Main battery, two 12-in., six 6-in. slow-fire; secondary rapid-fire battery, six 1-pounders, four 37-mm. Hotchkiss, two Gatlings. **Torpedo tubes**, two. **Authorized** 1886.

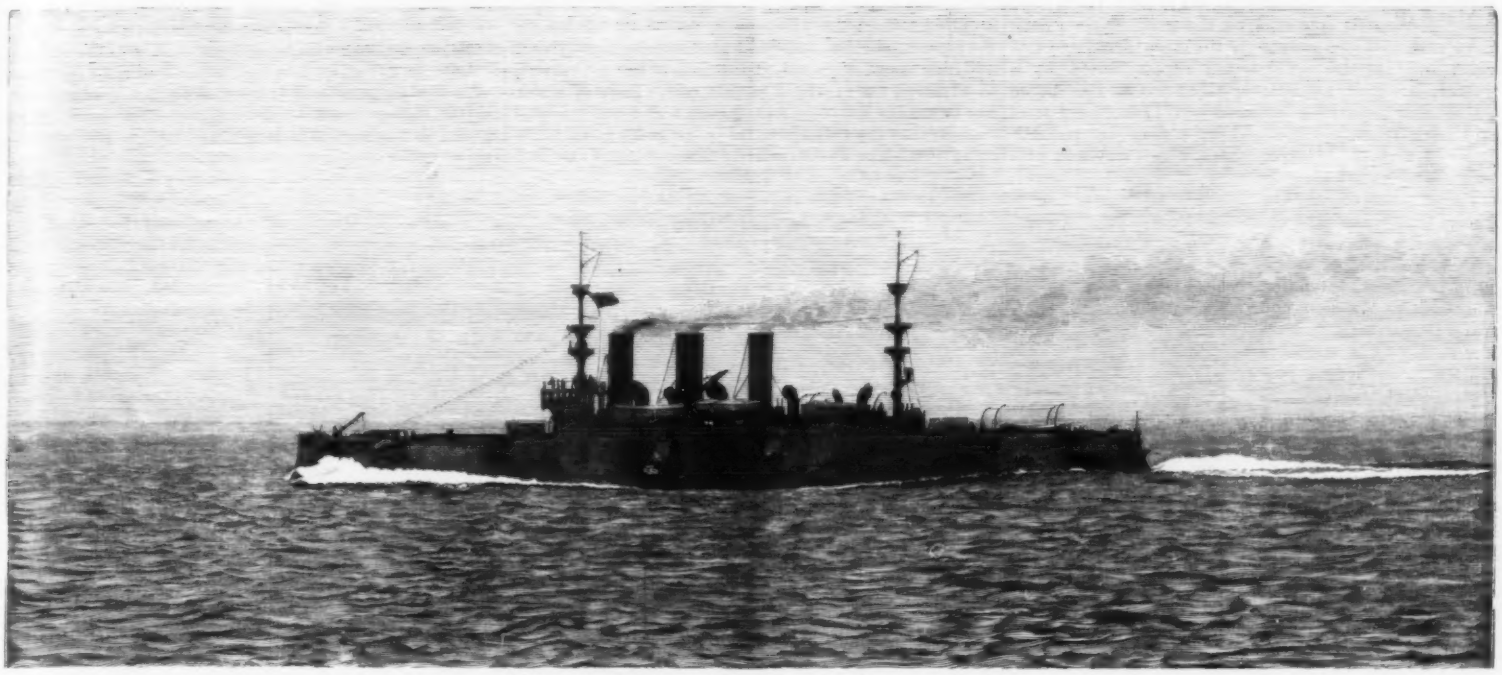
SECOND-CLASS BATTLESHIP "TEXAS."

The "Texas," authorized in 1886, was the first battleship to be built in the reconstruction of the new navy. She is rated as a second-class, her displacement being 6,315 tons, or not much more than one-half that of the "Alabama." Her plans were purchased in England as the result of a competition instituted by the naval department of the United States, in which Mr. William John, a naval architect of considerable note, was successful. There was considerable discussion as to the merits of the plans, subsequent to their purchase, and, as a result, the ship was not laid down until 1889, the plans in the meantime receiving certain modifications. The construction was undertaken at the Norfolk navy

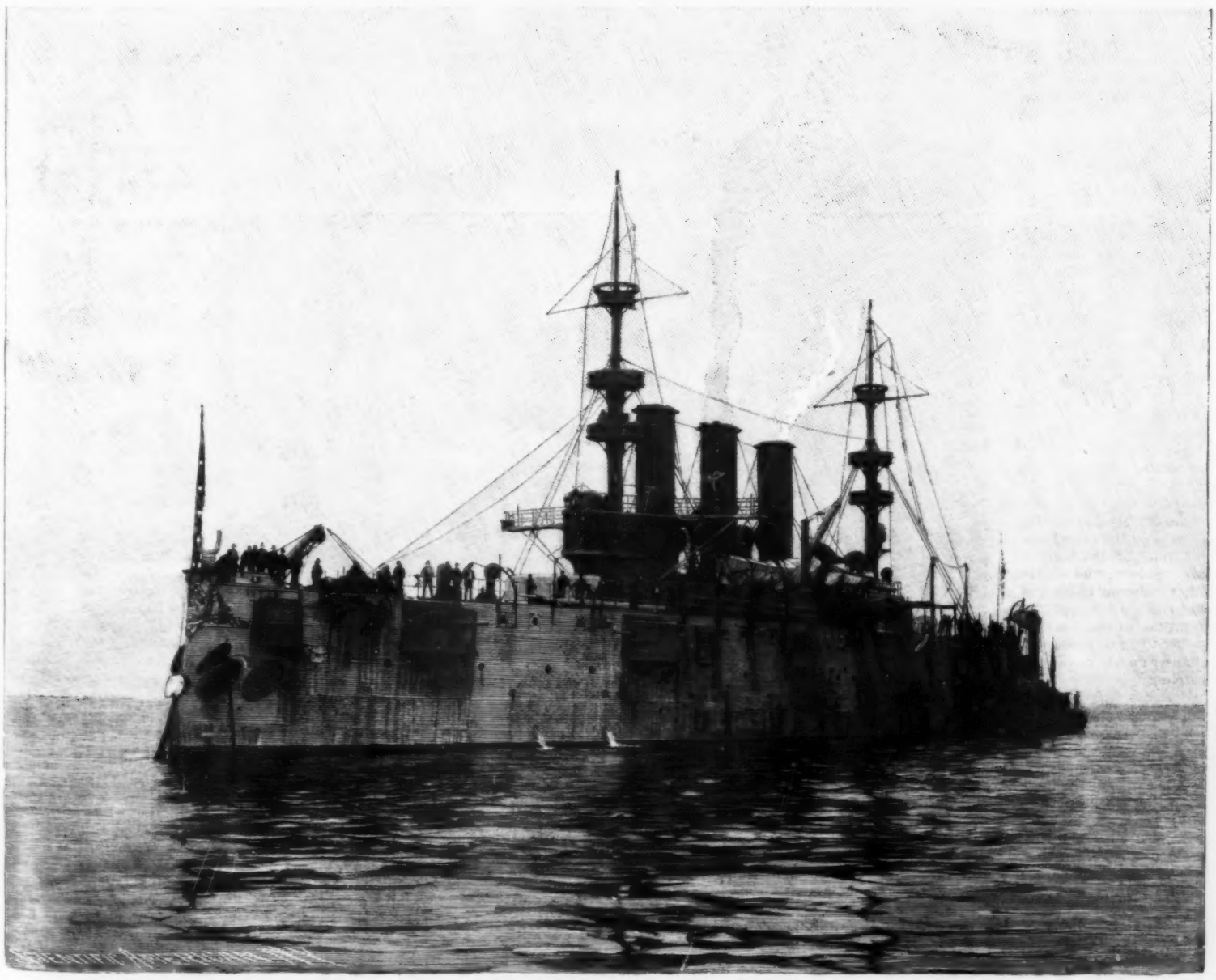
yard; the launch took place June 28, 1892, and the ship did not go into commission until August 15, 1895.

The "Texas" represents a type of battleship which was popular at the time when her plans were drawn. In those days the heaviest guns were frequently placed amidships in a central armor-plated redoubt, the object being to reduce the protected area and enable a greater thickness of armor to be used. In the "Texas" the two 12-inch guns, which constitute her principal battery, are sponsoned out one on each side of the ship, and they are placed diagonally to the axis, with the smokestack standing between them, the starboard gun lying somewhat astern and the port gun somewhat ahead of the smokestack. The object of arranging the guns en echelon, as it is called, was to enable them to obtain an all-round fire, both guns being able to fire at the same time dead ahead or astern or on the same broadside.

This arrangement has given place to the plan adopted in our later ships, like the "Indiana" and "Alabama," in which the main battery is disposed at opposite ends of the ship and on its longitudinal axis. The advantages of the latter plan are that the guns are more widely separated and are not in danger of being both disabled by one lucky shell from the enemy's big guns, that a more complete all-round fire is obtained, and that a larger area of the ship can be protected with



"NEW YORK" AT FULL SPEED 21 KNOTS AN HOUR.



ARMORED CRUISER "NEW YORK."

Displacement, 8,200 tons. **Speed**, 21 knots. **Maximum Coal Supply**, 1,290 tons. **Complement**, 550. **Armor:** Belt, 4 in.; deck, 3 to 6 in.; barbettes, 10 in.; turrets, 5½ in. **Guns:** Main battery, six 8-in., twelve 4-in. rapid-fire; secondary rapid-fire battery, eight 6-pounders, two 1-pounders, four Gatlings, two field guns. **Torpedo tubes**, two. **Authorized** 1888.

armor. For it is evident that in the case of the "Texas" if a hostile ship took up her position off the port bow or the starboard quarter, only one of the heavy guns could be trained on her, the smokestack interfering with the training of the other gun.

Of course, two could play at that game, and the "Texas" would maneuver to keep her opponent from placing herself in those positions. In this her good speed, nearly 18 knots, and her quick turning ability would be of great assistance. The 12-inch guns are supplemented by a battery of six 6-inch rifles, two being carried in sponsons on the gun deck on each broadside and two others on the main deck, one forward and one aft. These are supplemented by a numerous battery of smaller rapid-fire and machine guns. The turrets are armored with 12 inches of steel and their bases are inclosed by a diagonal redoubt armored with 12-inch steel plates, which serves to protect the hydraulic machinery used for operating the guns. The boilers and engines are protected by a nickel-steel belt of armor 12 inches thick, extending 2 feet above the designed water line and 4½ feet below it, having a length of 116 feet. There is a protective deck built of 2-inch steel above the armor belt.

In spite of the proverbial bad luck which has followed her from the first, the "Texas" is said to be a popular ship with her officers and crew. She has a good freeboard and carries her guns high above the water—an invaluable quality at all times—and she is one of the steadiest ships in the navy, presenting an excellent gun platform. She now forms one of the Flying Squadron, under Commodore Schley, at Hampton Roads, for which her high speed and handiness render her well adapted.

CRUISERS.

THE cruisers are the light cavalry of the navy. As their name implies, their duty is to cruise the seas, keeping touch with the enemy's fleets and acting as the "eyes" of the line-of-battle ships. They are also intended for the double duty of attacking an enemy's commerce and defending that of the country whose flag they carry. Fleets of merchant vessels or of transport ships will be "convoyed" by cruisers from port to port. Upon the cruiser will devolve the duty of hunting down, capturing or sinking the armed merchantmen, known as auxiliary cruisers, and the regular cruisers of the enemy, and she must be ready at any time to make a dash at her topmost speed with important naval dispatches.

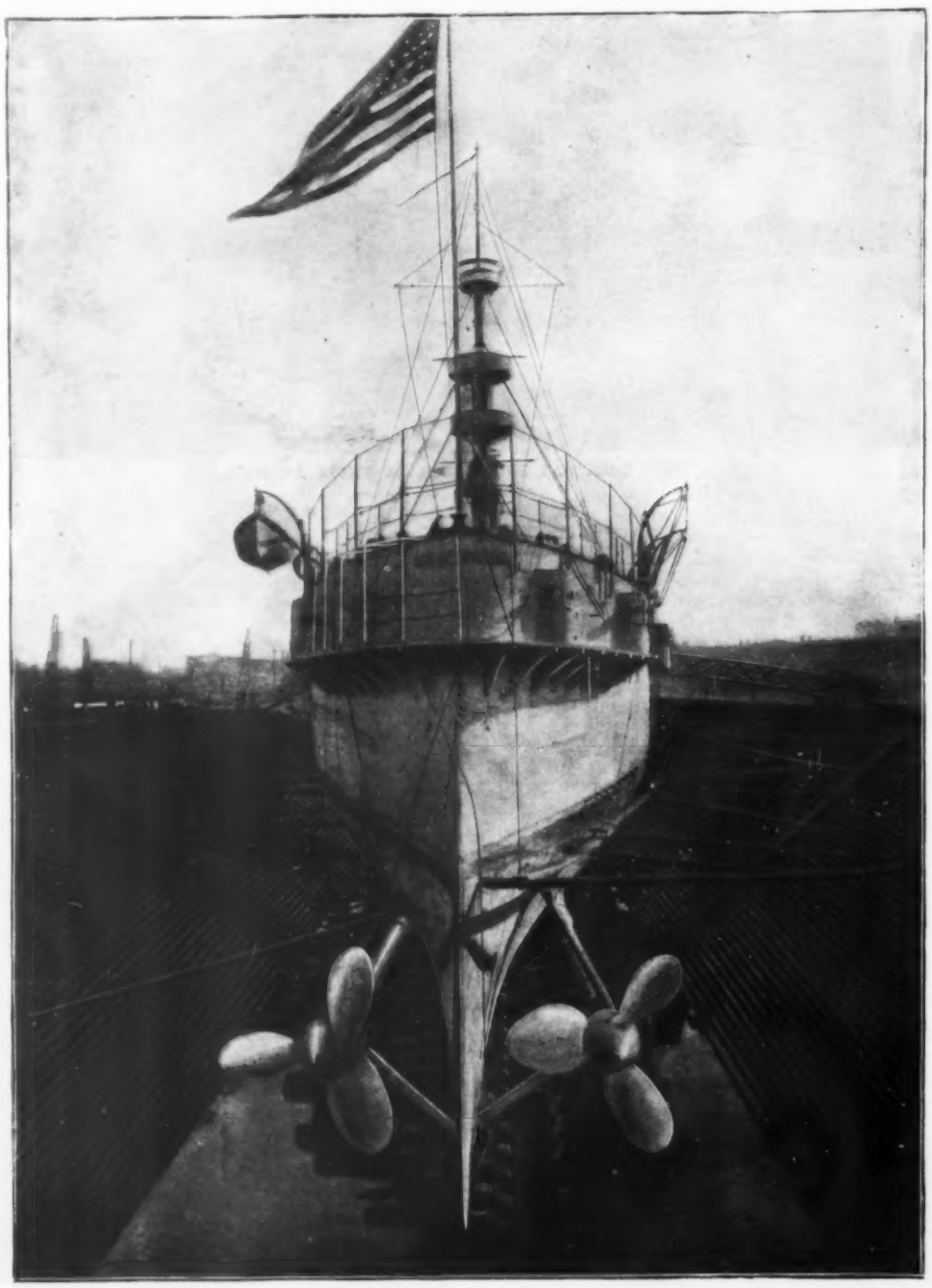
For these special duties she requires to be a good sea boat with high freeboard, adapted for steaming at a high rate of speed in all weathers. She must be furnished with powerful engines, and her lines must be fair and fine; she must have a large coal supply, enabling her to keep the sea for lengthy periods; she must have ample berthing space for a numerous crew, some of whom will have to be placed aboard her prizes to carry them to a home port; and, finally, she must be armed with a powerful battery of medium caliber guns, to enable her to fight ships of her own class.

These many requirements have evolved the swift protected cruiser of to-day (see Fig I. page 3) with its high speed, light armor, and moderate armament. Out of the protected cruiser, which relies entirely upon a curved deck to keep out the shells, has come the armored cruiser (Fig. II. page 3), in which an attempt is made to combine the speed of the cruiser with something of the offensive and defensive powers of the battleship. A belt of thin side armor is added, the guns are heavier, and are placed behind heavier armor, while the feature of high speed is maintained.

The earlier ships of our navy were entirely of the cruiser class, and at the present time these ships constitute the most numerous portion of our fleets.

THE ARMORED CRUISER "NEW YORK."

Perhaps it is safe to say that there is no more widely known and popular ship in the new navy than the great armored cruiser "New York." Certainly there is none more handsome, unless it be that other imposing armored cruiser, the "Brooklyn," for which she formed the prototype. Her imposing proportions, great power and high speed did much at the time of her appearance to advertise the excellent quality of the ships of which our new navy was being composed. She was selected to represent the United States at the great naval gathering at Kiel, on the occasion of the opening of the Baltic Canal, where she won unstinted praise from the many naval experts who inspected her.



ARMORED CRUISER "NEW YORK"—STERN VIEW.

The "New York" was authorized in 1888, and was built under a programme which called for eight new vessels, the most important of which was to be an armored cruiser of 7,500 tons displacement. As actually built, the "New York" is larger, displacing 8,200 tons. She was built by the Cramp Company from designs furnished by the Bureaus of Construction and Steam Engineering, and it is no exaggeration to say that from the day she was put into the water she has been an unqualified success. Her length is 380 feet 6⅛ inches; beam, 64 feet 10 inches; and mean draught, 23 feet 3½ inches. Her ram bow and high freeboard are conspicuously noticeable as the vessel is seen at anchor, the 8-inch rifles she carries being 25 feet above the water. She has two of these rifles in a barbette forward on the main deck, two in a similar barbette aft, and two are carried in broadside amidships. She has also twelve 4-inch rapid-fire guns on the gun deck protected by 4 inches of steel, eight rapid-fire 6-pounders, two rapid-fire 1-pounders, four Gatling guns, and two field guns for landing parties; she also carries two torpedo tubes. The men working the rifles in the barbettes are protected by 10 inches of steel armor, and the revolving turrets are 7 inches thick. The protective deck is 3 inches thick on the flat and 6 inches on the sloping sides, which incline from 1 foot above to 4 feet 9 inches below the water line. To the protection afforded by this deck is added the protection of a vertical belt of steel 4 inches thick, which extends amidships at the water line in the wake of the engines and boilers.

A novel arrangement of the engines was inaugurated on the "New York." Each of the twin screws is driven by two complete triple-expansion engines working on the same shaft, a coupling being placed between each pair of engines. This was done with a view to using only the after engines for cruising purposes, the forward ones being uncoupled. The high pressure cylinders are 32 inches the intermediate 47 inches, and the low pressure cylinders 72 inches in diameter, the stroke of all cylinders being 42 inches. Steam is furnished by six double-ended main boilers and two single-ended auxiliary boilers, with a total heating surface of 32,958 square feet. On her trial trip the ship averaged 21 knots for four consecutive hours.

The naval board having charge of the trial, of which Rear Admiral Belknap was president, said it "feels justified in recording its opinion that in the 'New York' the navy of the United States will possess a vessel which, as a combination of superior speed, good armored protection, disposition of battery, excellent sea-going qualities, and rare habitability, leaves little if anything to be desired for the purpose she was designed to fulfill." At the conclusion of the trial the forward engines were uncoupled and the vessel was run for eight hours under two engines and four boilers, with which she logged about 16 knots an hour.

One of our illustrations shows the "New York" when she was traveling at her full speed of 21 knots or 24 miles an hour, and it shows very clearly the wave line and the mass of broken water thrown up at the stern. The photograph showing a stern view of the vessel was taken while the cruiser was in dry dock No. 2 at the Brooklyn Navy Yard, being prepared for her hurried trip to Brazil during the recent rebellion. The two propellers are of manganese bronze, 16 feet in diameter and of 20 feet pitch. This view shows the great sweetness of the lines aft, a feature which contributes at once to her beauty and high speed.

THE ARMORED CRUISER "BROOKLYN."

The act of Congress of July 19, 1892, which authorized the construction of the "Iowa," also called for the construction of one armored cruiser of the general type of the "New York." The construction of both ships was undertaken by the Cramp Shipbuilding Company, the plans being furnished by the government bureaus.

The "Brooklyn" is an improved and enlarged "New York,' as will be seen from the following comparison:

	Length.		Beam.		Draught.		Displacement.	Horse Power.	Speed.
	Ft.	In.	Ft.	In.	Ft.	In.	Tons.		
Brooklyn	400	0	64	8¾	24		9,215	18,769	21·91
New York	380	6⅛	64	10	23	3½	8,200	17,401	21·09

Her coal capacity, moreover, is 1,461 tons, as against 1,200 tons for the "New York."

As regards armament, the "Brooklyn" carries eight 8-inch guns, as against six of this caliber carried on the "New York," and her broadside battery of rapid-fire guns is of far greater weight and power. In the "New York" this battery is carried on the gun deck and is well distributed throughout the full length of the ship. It consists of 4-inch rapid-fire guns, which fire a 33-pound shell with a muzzle energy of 915 foot-tons; but on the "Brooklyn" the main rapid-fire battery is made up of much more powerful weapons, the new 5-inch rapid-fire gun being used. This fires a 50-pound shell with a muzzle velocity of 2,300 feet per second and an energy of 1,834 foot-tons, the muzzle penetration being 13 inches of iron. Eight of these guns are carried on the gun deck and protected by Harveyized steel, and four are carried on the main deck above, upon which are also six of the 8-inch rifles.

At first glance one is struck with the odd appearance of the three unusually lofty smokestacks and the exceptionally high forecastle deck. Warships, however, are not built for appearance; and these two features, though they may detract from her beauty as compared with the "New York," make her a much more effective fighting machine. The lofty forecastle enables her to carry her forward pair of 8-inch guns some 8 feet higher than the "New York," or about 30 feet above the water line, and she could fight them when steaming against a head sea that would be apt to flood and put out of action the same guns on a ship with a lower freeboard. This is a very valuable feature in a ship that will often have to chase an enemy that is steaming against the wind. The lofty smokestacks give the result which is usually obtained by the use of forced draught—a device which experience has proved liable to be destructive to the boilers. In the forced draught system, the cold air impinging on the tube-plate, when the furnace door is opened for firing, causes severe expansion and contraction strains, and frequently starts leakage at the tube ends. There is less difficulty of the kind attaching to natural draught, and experience in the mercantile marine has shown that as good results can be obtained by lengthening the smokestacks as by the employment of the forced draught system.

In addition to the forward pair of 8-inch bow-chasers, the forward pair of 5-inch guns on both the main and gun decks are sponsoned well out from the sides of the ship, enabling them to fire dead ahead; moreover, she can concentrate the fire of the two pairs of 8-inch guns which are carried on either beam amidships, the barbettes being carried well out from the ship for this purpose. The ship can converge the same weight of gun fire astern, and on the beam it is still heavier, being increased by the addition of the two 5-inch guns amidships.

The important feature of interference has been carefully provided for, and no gun will be hampered by the blast from the others.

The "Brooklyn" has the large coal supply of 1,461 tons, which will give her a radius of action of 6,088 knots at a 10-knot speed. The protection consists of a protective deck 3 inches thick on the flat and 6 inches on the slopes. The belt is 3 inches thick and between belt and slopes is a protection of coal. The water line is further protected by working in a water-excluding material, prepared from cocoa fiber, along the sides of the vessel. In the next naval operation of the United States we may confidently look for great things from this handsome and formidable ship.

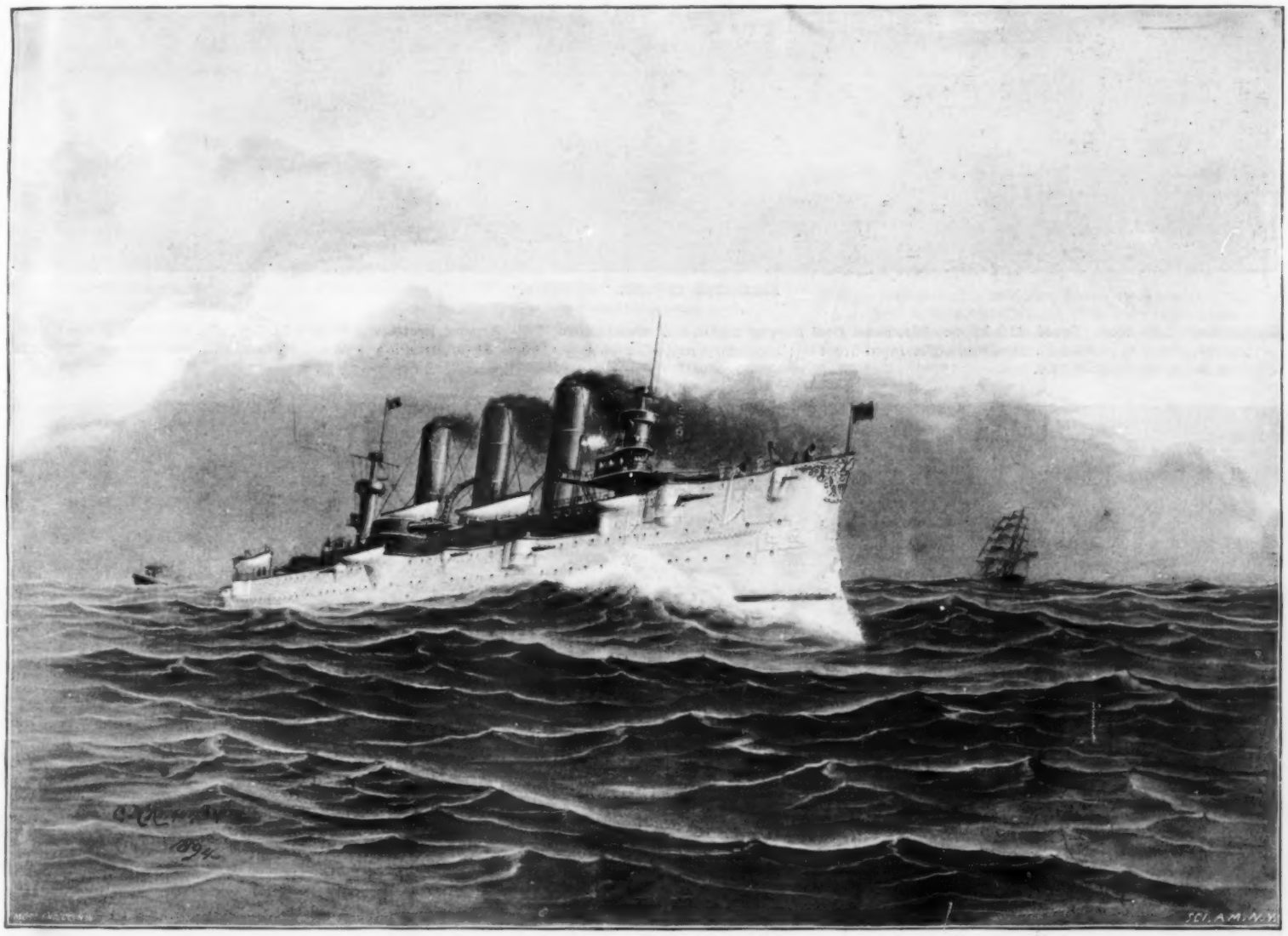
THE PROTECTED CRUISER "COLUMBIA."

The protected cruiser "Columbia" differs from the armored cruisers "New York" and "Brooklyn" in her greater speed and her lighter armor and guns. She was authorized at the same time as the "Indiana" type of battleships, the act calling for "a protected cruiser of about 7,300 tons displacement, to have a maximum speed of 21 knots."

Both the "Columbia" and her sister ship the "Minneapolis," authorized in the following year, created a considerable sensation both when their designs were first made public and when they achieved their phenomenal trial speeds. The "Columbia" was designed to act as a commerce destroyer. Hence she was given great length, 412 feet, fine lines and extreme horse power—the indicated horse power on the trial being 18,509. Her protection consists of a steel deck 2 inches on the flat and 4 inches on the slopes. The armament is light for a ship of her size, consisting of two 6-inch guns at the bow, one 8-inch gun at the stern, for stopping a more powerful enemy who might be giving chase, and a broadside battery of eight 4-inch rapid-fire guns.

One of the most interesting features of this vessel lies in the machinery, with its triple set of screws and three independent triple-expansion engines. One screw (see illustration, page 19) is located immediately in front of the helm on the axis of the ship, and is of 10 degrees more pitch than the others. The two other screws are located one on each side of the stern, about 15 feet forward of the middle screw, and about 4 feet 6 inches above it, the shafts inclining outward and upward, while the middle shaft is inclined slightly downward. The two side screws were set to the pitch found most advantageous on actual trial. By the triple screw arrangement the chances of a breakdown are lessened. If twin screws had been used, over 9,000 indicated horse power would have had to pass through one shaft to obtain the 18,509 horse power developed at the trial. With three screws, each shaft is subjected to a strain not exceeding 6,170 horse power per shaft. The shafting is of forged steel, 16½ inches diameter. For ordinary cruising, using the central screw alone, a speed of about 15 knots is obtained; with the two side screws alone a speed of 17 to 19 knots can be maintained, and with all three screws at work at full power a high speed of 22·08 knots was got out of the vessel. The screws are disconnected when not driven by the engines, so as to reduce their resistance.

It was claimed by some critics of the "Columbia" that although she showed a remarkably high speed on her trial trip, she would not be capable of maintaining a high continuous sea speed on a lengthy trip across the Atlantic. The government bureaus responsible for her design and her builders were equally satisfied that she could stand the test of an ocean voyage, and eventually the Secretary of the Navy ordered her to cross from Southampton to New York at full speed. She left Southampton shortly after noon on Friday, July 26, 1895, and reached Sandy Hook the following Friday, the distance of 3,090 knots having been covered in 6 days 23 hours 49 minutes, at an average speed of 18·41 knots an hour. The trial was made under natural draught throughout the whole trip. It had originally been intended to use forced draught on the last day, but the force of coal passers was insufficient to bring



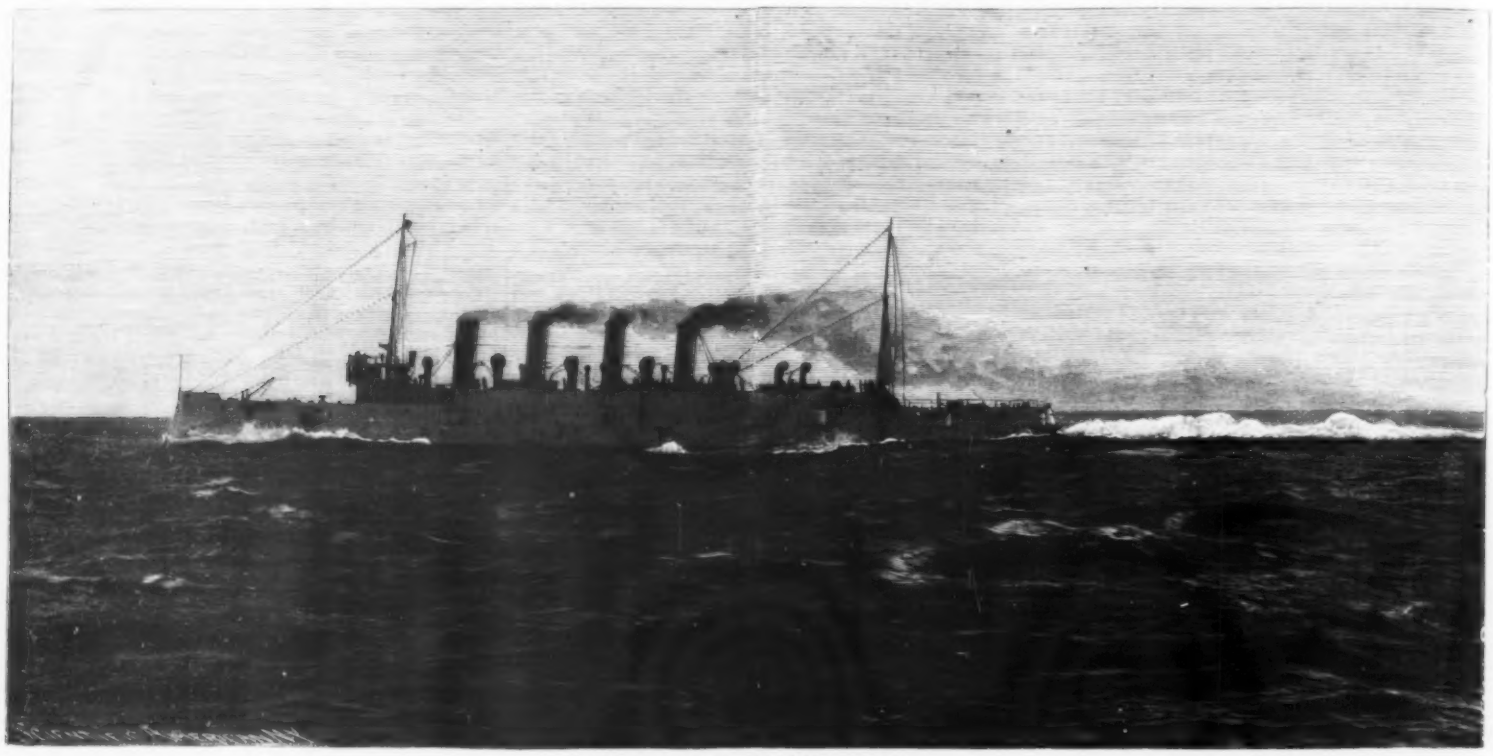
ARMORED CRUISER "BROOKLYN."

Displacement, 9,215 tons. **Speed**, 21·9 knots. **Maximum Coal Supply**, 1,461 tons. **Complement**, 516. **Armor:** Belt, 3 in.; deck, 3 to 6 in.; barbettes, 8 in.; turrets, 5½ in. **Guns:** Main battery, eight 8-in.; twelve 5-in. rapid-fire; secondary battery, twelve 6-pounders, four 1-pounders, four Colts, two field guns. **Torpedo tubes**, four. **Authorized** 1892.

the coal from the more remote bunkers on the last day fast enough to supply the fires.

THE PROTECTED CRUISER "MINNEAPOLIS."

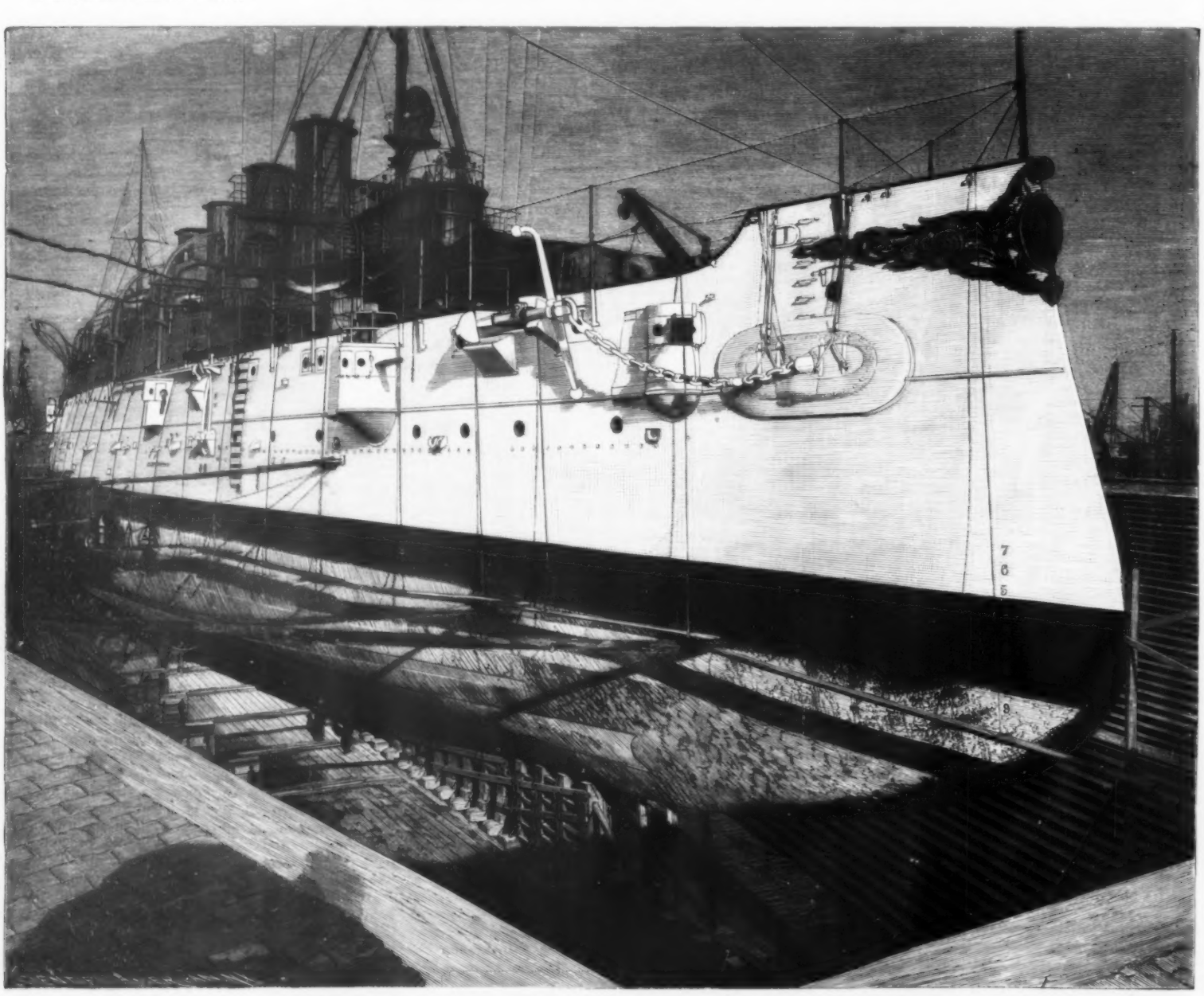
The "Minneapolis" was authorized in the year following the authorization of the "Columbia." She is called a sister ship, though she varies from the earlier vessel in some details of design and in her outward appearance, which is greatly changed by the substitution of two smokestacks of large diameter for the four smaller stacks on the "Columbia." She carries 221 tons of coal more than the earlier ship, and her boilers are provided with one-seventh more grate area. On



PROTECTED CRUISER "COLUMBIA."

(Photographed at 22·8 knots speed.)

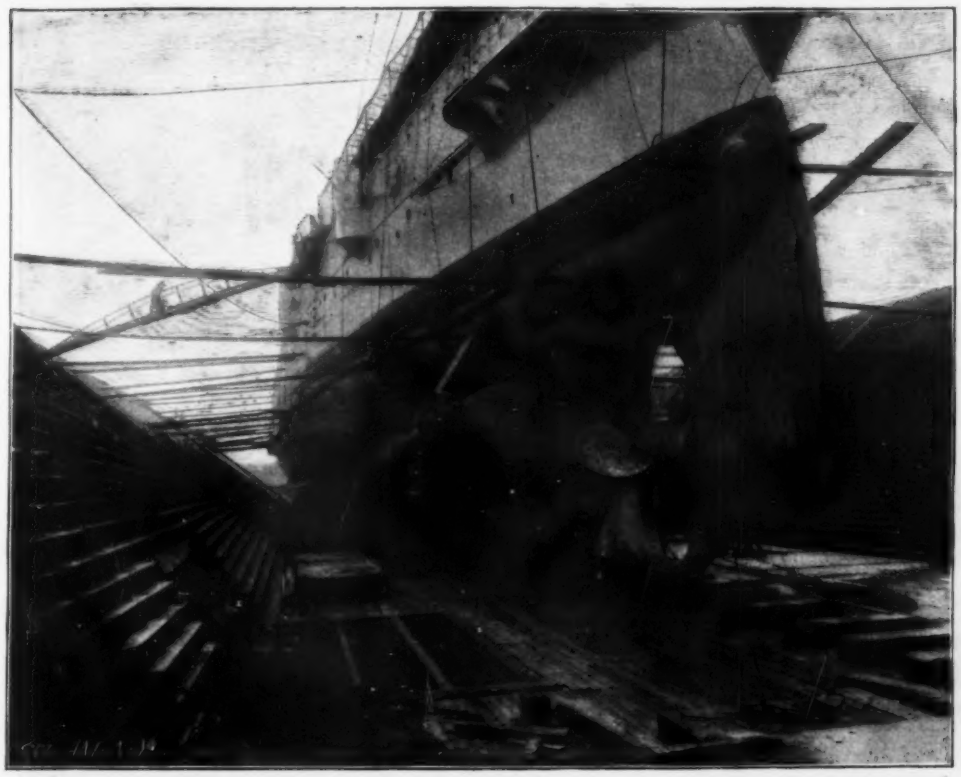
Displacement, 7,375 tons. **Speed,** 22·8 knots. **Maximum Coal Supply,** 1,670 tons. **Complement,** 556. **Armor:** Protective deck, 2 in. flat, 4 in. on slopes. **Guns:** Main battery, one 8-in., two 6-in. slow-fire, eight rapid-fire 4-in.; secondary rapid-fire battery, twelve 6-pounders, four 1-pounders, two Colts, one field gun. **Torpedo tubes,** four. **Authorized** 1890.



PROTECTED CRUISER "COLUMBIA" IN DRY DOCK No. 2 BROOKLYN NAVY YARD.

her trial trip she showed herself faster, covering the course at a speed of 23·07 knots, as against 22·8 knots achieved by the "Columbia," her engines indicating 20,862 horse power.

The accompanying illustration is from a photograph taken while the ship was running at her highest speed on her trial trip. The course was laid out from Cape Ann, Mass., to Cape Porpoise, Me., and was marked by eight government vessels anchored along it. Everything was favorable to the trial, the weather being calm for the greater part of the time. When within two or three miles of the starting point forced draught was put on and she entered the course at the rate of 23 knots. With her speed varying from 21 to over 24 knots, the first half of the course was completed. The ship then executed a long turn, and at high speed entered the other end of the course for the second run. The early portion of the return trip was made at the rate of 25·2 knots, and when the entire distance of nearly 88 marine miles was completed, the average speed, as deduced with the corrections for tide, was 23·073 knots per hour.



CRUISER "COLUMBIA" IN DRY DOCK No. 2 BROOKLYN NAVY YARD, SHOWING THE ARRANGEMENT OF TRIPLE SCREWS.

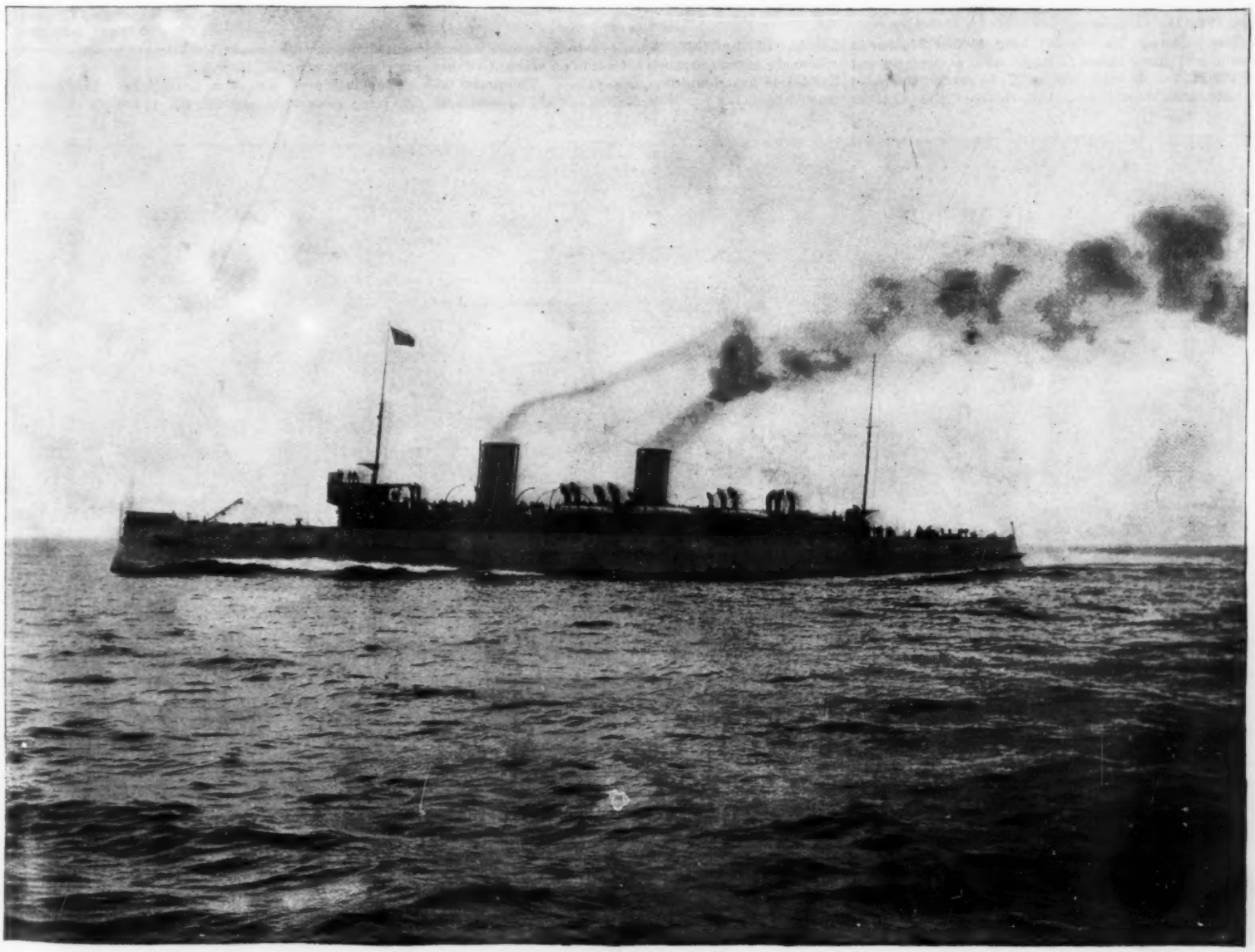
The illustrations of both the "Columbia" and the "Minneapolis" are of special interest, on account of the great speed at which they were taken. The wave line is very clearly defined, as is the crest of broken water thrown up by the triple screws.

PROTECTED CRUISER "CINCINNATI."

The "Cincinnati" and her sister ship the "Raleigh" were authorized in 1888, and by the direction of the Secretary of the Navy were constructed at the government navy yards, the "Cincinnati" at Brooklyn and the "Raleigh" at Norfolk.

The "Cincinnati" is 300 ft. long, 42 ft. beam and has a draught of 18 ft., with a displacement of 3,213 tons. With an indicated horse power of 10,000, she has a speed of 19 knots. Her bunker capacity is 400 tons, and her maximum draught, loaded for sea, is 20 ft. 2 in. The engines were constructed at the Brooklyn Navy Yard, and it is claimed that in cost per horse power and in performance they compare favorably with the engines built by contract. The ship is driven by twin screws, and the engines are of the triple-expansion type with four cylinders, the high pressure, intermediate and the two low pressures. Two low-pressure cylinders were used on account of the difficulty in finding room for one large cylinder, on account of the narrowing of the ends of the ship.

The armament is heavy, consisting of ten 5-inch rapid-fire guns and one 6-inch slow-fire gun, together with a numerous battery of smaller rapid-fire and machine guns. The 6-inch gun is mounted on a bow chaser on the forecastle deck, and two of the 5-inch guns are mounted at the same height on the poop, one on either



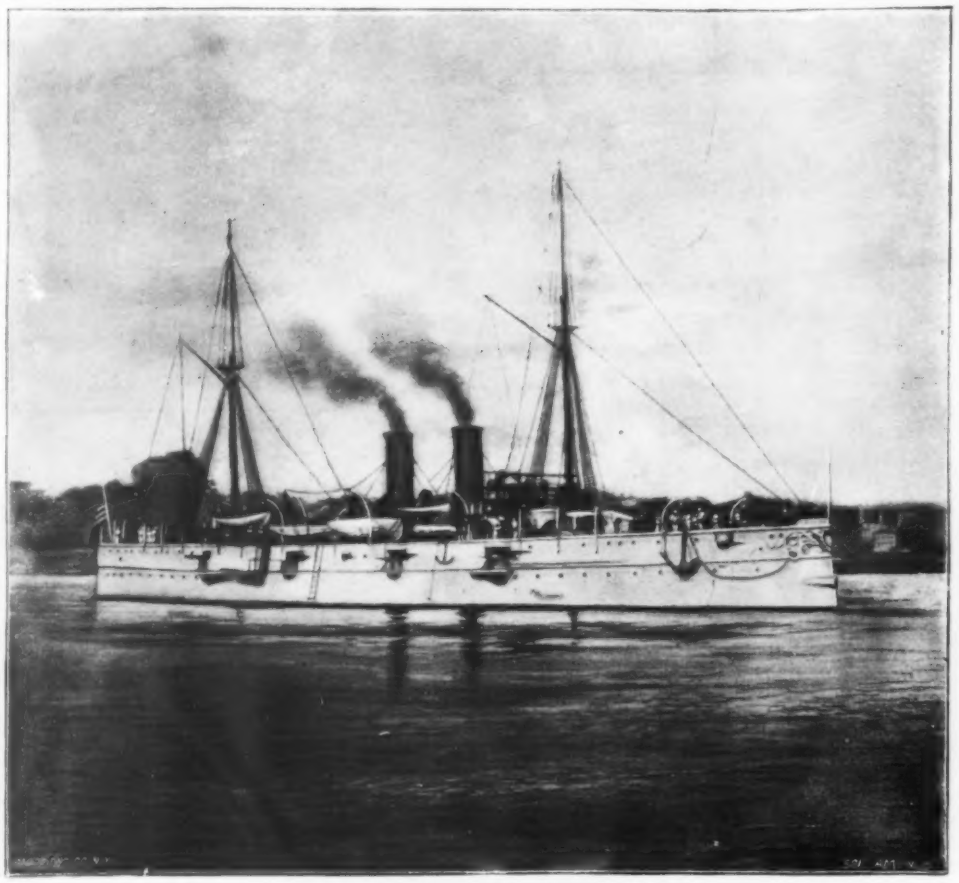
PROTECTED CRUISER "MINNEAPOLIS."

(Photographed at 23·07 knots speed.)

Displacement, 7,375 tons. Speed, 23·07 knots. Maximum Coal Supply, 1,891 tons. Complement, 556. Armor: Protective deck, 2½ in. on flat, 4 in. on slopes. Guns: Main battery, one 8-in., two 6-in. slow-fire, eight rapid fire 4-in.; secondary battery, twelve 6-pounders, four 1-pounders, two Colts, one field gun. Torpedo tubes, four. Authorized 1891.

beam. Of the other 5-inch guns, two are carried on the gun deck forward beneath the forecastle deck, two aft on the same deck beneath the poop and the other four are carried amidships in the open waist of the vessel. The guns beneath the forecastle and poop are sponsoned well out from the sides of the vessel, so as to allow them to fire respectively dead ahead and dead astern.

The disposition of the guns is excellent, and as all of them but one are of the rapid-fire type, these ships are among the most formidable fighting machines for their size in the navy. Judging them on the basis of weight of shell thrown in a given time per ton of displacement, they are unsurpassed, unless it be by the United States cruiser "Olympia" or the recently acquired "New Orleans."



PROTECTED CRUISER 'CINCINNATI."

Displacement, 3,213 tons. **Speed**, 19 knots. **Maximum Coal Supply**, 460 tons. **Complement**, 314. **Armor:** Protective deck, 1 in. on flat, 2½ in. on slopes. **Guns:** Main battery, one slow-fire 6-in., ten rapid-fire 5-in.; secondary rapid-fire battery, eight 6-pounders, two 1-pounders, two Colts, one field gun. **Torpedo tubes,** two. **Authorized** 1888.

PROTECTED CRUISER "CHICAGO."

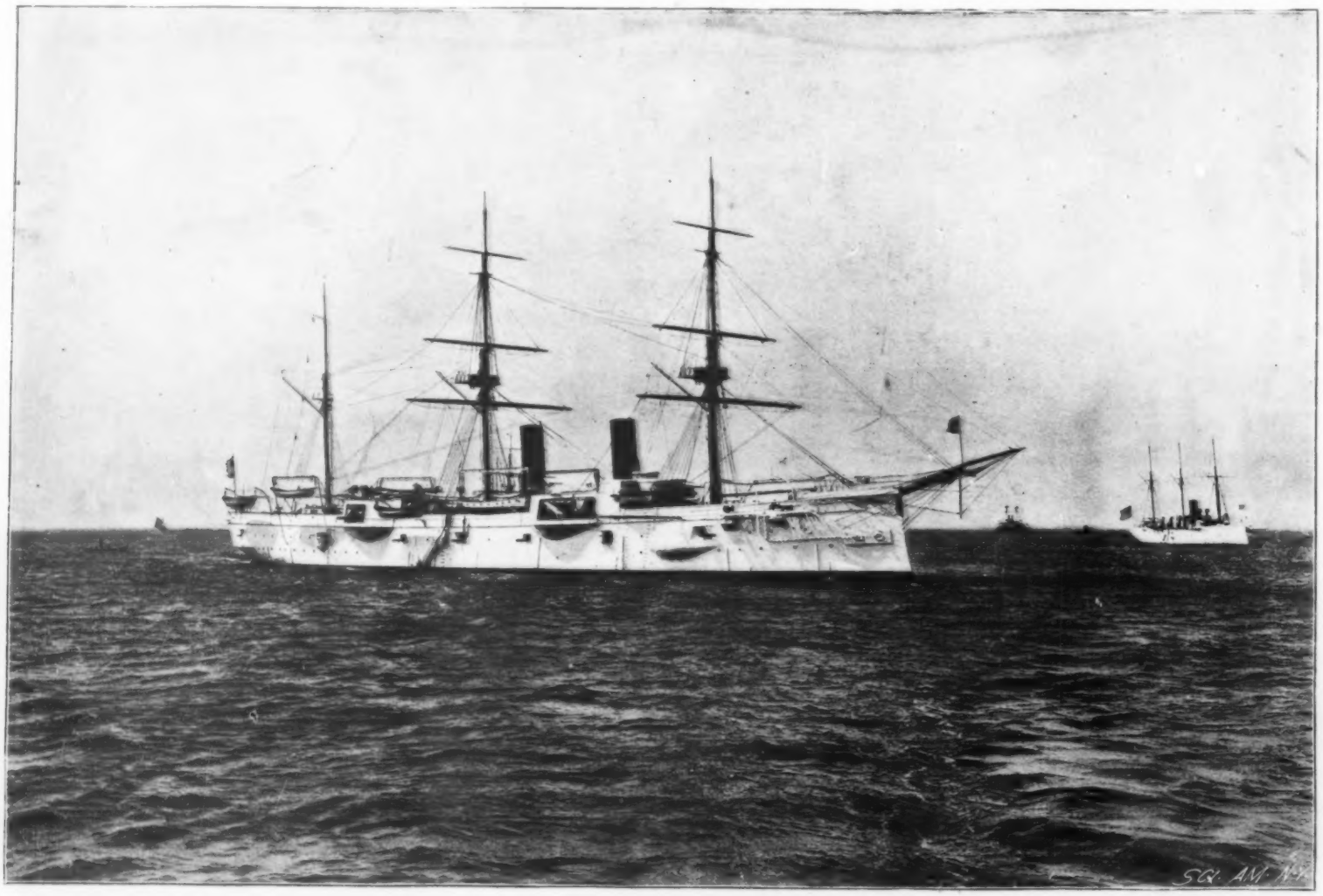
This very handsome vessel was the largest and most powerful of the three protected cruisers which formed the nucleus of the new navy, the others being the twin ships "Atlanta" and "Boston." Like them, she was contracted for by John Roach, of Philadelphia, and partly constructed in his yards. After his failure she was completed by the government.

The "Chicago" is 325 feet long, 48 feet 2 inches in beam and draws 19 feet of water, with a displacement of 4,500 tons. As originally built, she carried the rig of a bark, and it was under this rig that she went as flagship of the White Squadron to European waters, where she attracted much attention on account of her handsome model and fine proportions. The praise bestowed upon her was well merited, as will be seen from the accompanying engraving of the flagship. Unlike the "Atlanta" and "Boston," she has a high freeboard, the heavier guns being carried a deck higher above the water than on those ships, and this renders her a dry and comfortable ship in bad weather, and allows more liberal berthing space for the crew, who number, all told, 376 men.

The main battery was made up of four 8-inch guns, eight 6-inch and two 5-inch slow-firers, and a secondary rapid-fire battery of seven 6 pounders, two 1-pounders, and three machine guns. The 8-inch guns were mounted on the main deck in sponsons carried well out to secure a good train forward and aft, and they were protected by shields. Below on the gun deck were the 6-inch and 5-inch guns in broadside, the two forward and the two aft guns being also sponsoned out. The secondary battery was variously distributed throughout the ship.

In the remodeling of the ship, which is being carried out at the Brooklyn Navy Yard, the 6-inch and the 5 inch slow-fire guns are being replaced by a battery of 5-inch rapid-fire guns, thereby greatly increasing the offensive power of the ship. The secondary battery has also been changed, as shown in the tabulation accompanying the illustration of the ship.

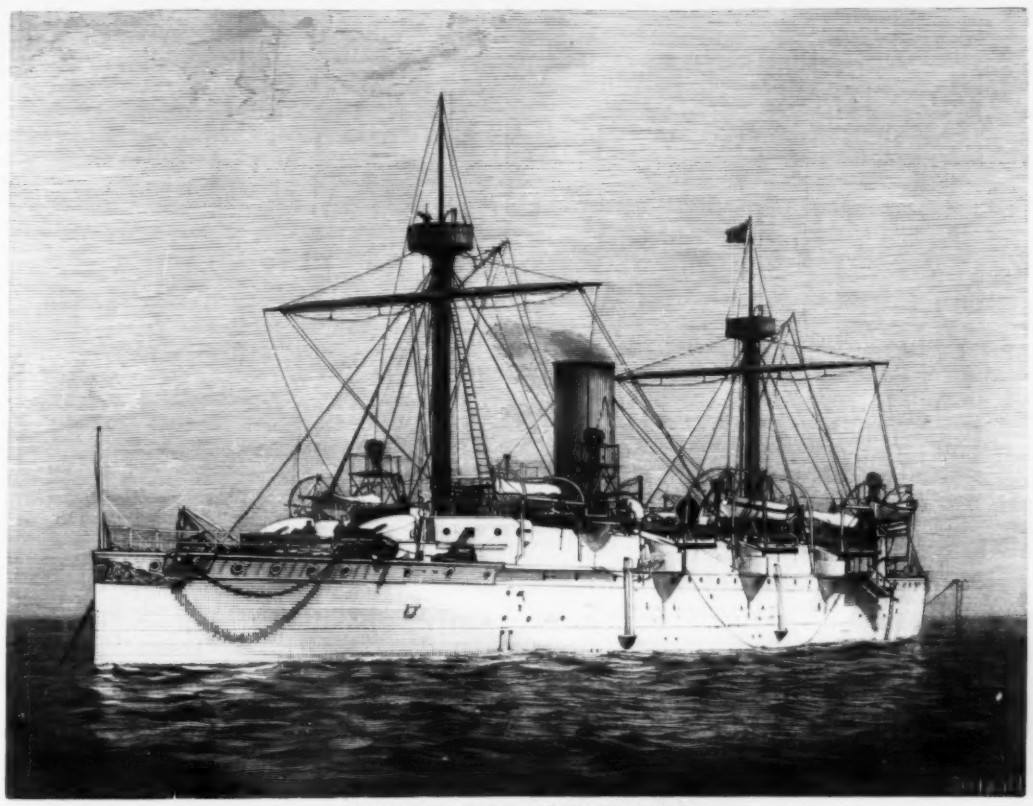
The machinery was of a novel type. There were two large compound engines, the cylinders of which



PROTECTED CRUISER "CHICAGO."

Displacement, 4,500 tons. **Speed** (estimated), 18 knots. **Maximum Coal Capacity**, 832 tons. **Complement**, 409. **Armor:** Protective deck, 1½ in. throughout. **Guns:** Main battery, four 8-in., fourteen rapid-fire 5-in.; secondary rapid-fire battery, seven 6-pounders, two 1-pounders, two Colts, one field gun. **Authorized** 1883.

were placed one on each side of the center line of the ship and connected to overhead athwartship walking-beams, which served to drive the crankshafts on the opposite side of the ship. Thus the starboard cylinder drove the port screw shaft and vice versa. The boilers were of the externally fired return-tube cylindrical type, the furnaces being bricked up around the outer shell. These engines and boilers gave good service during the six or seven years that the "Chicago" was in commission, but they are now to be replaced by modern triple-expansion engines and nickel-steel boilers, the latter, by the way, the first of the kind to be used in the navy.



PROTECTED CRUISER "CHARLESTON."

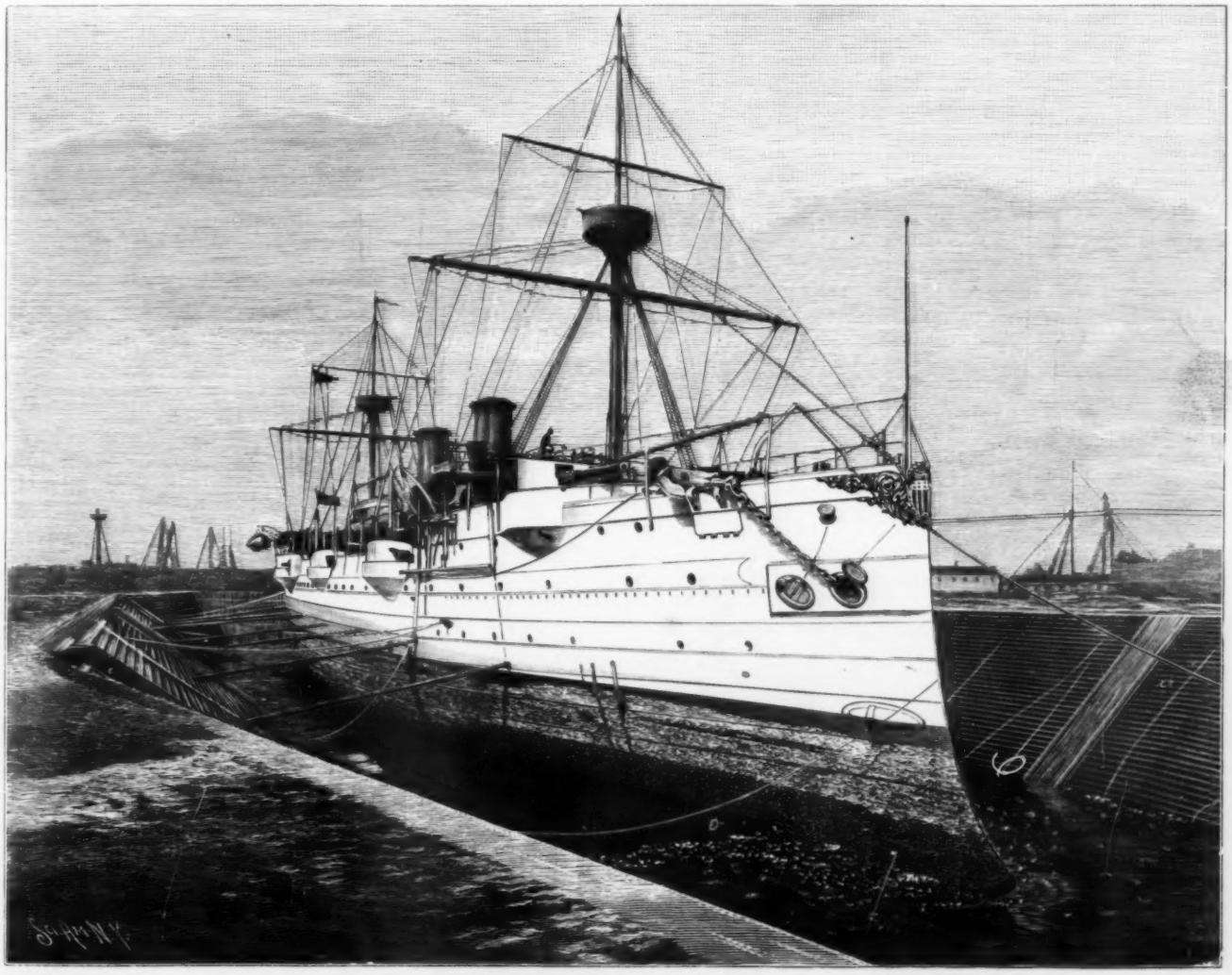
Displacement, 3,730 tons. **Speed**, 18·2 knots. **Maximum Coal Supply**, 758 tons. **Complement**, 306. **Armor:** Protective deck, 2 in. on flat, 3 in. on slopes. **Guns:** Main battery, two 8-in., six 6-in. slow-fire; secondary rapid-fire battery, four 6-pounders, two 3-pounders, two 1-pounders, four 37-mm. Hotchkiss, two Colts, one field gun. **Authorized** 1885.

PROTECTED CRUISER "CHARLESTON."

The protected cruiser "Charleston" was authorized in 1885, the bill calling for the construction of two cruisers and two gunboats. The ships built under this programme were the cruisers "Charleston" and "Newark" and the gunboats "Yorktown" and "Petrel." The plans for the "Charleston" were purchased from the Armstrongs and had to be considerably revised by the builders, the Union Iron Works of San Francisco, the most notable changes being made in the machinery.

The dimensions of this ship are: Length 312 feet 7 inches, beam 46 feet 2 inches, draught 18 feet 7 inches and displacement 3,730 tons. She is driven by twin-screw, horizontal, compound engines of 6,666 indicated horse power. These engines were among the last of this type to be put into a ship for our navy. Horizontal engines were used in the earlier warships to allow of the cylinders being placed well below the water line, but the use of the protective deck, strengthened in the wake of the cylinders and protected by coal bunkers, has enabled the designers to give ample protection to engines of the vertical type. The problem of protection has been simplified, moreover, by the high piston speed now in vogue, and the higher steam pressures, which enable a much shorter stroke to be used, bringing the tops of the cylinders well down to the water line. The contract called for an indicated horse power of 7,000, with a corresponding speed of 18 knots an hour. On her four hours' trial the ship failed to reach the horse power, indicating only 6,666, but she exceeded the speed by 0·20 of a knot, and at times during the four hours' run she made as high as 19 knots.

The "Charleston" carries two 8-inch guns, one forward and the other aft, and six 6-inch slow-firers in broadside, the guns being all protected by shields. She has a single large funnel and two military masts. The ship has proved a serviceable cruiser, and during the nine years since she was first put in commission she has been employed on the Pacific coast. She is at present being overhauled at the Mare Island Navy Yard, San Francisco.

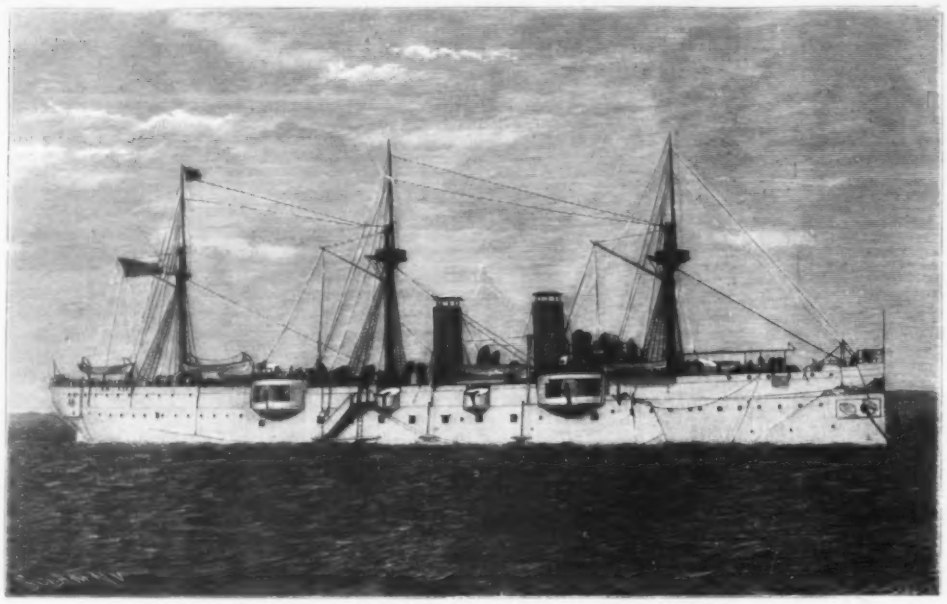


PROTECTED CRUISER "BALTIMORE."

Displacement, 4,413 tons. **Speed**, 20·1 knots. **Maximum Coal Supply**, 1,144 tons. **Complement**, 386. **Armor:** Protective deck, 2½ in. on flat, 4 in. on slopes. **Guns:** Main battery, four 8-in., six 6-in. slow-fire; secondary rapid-fire battery, four 6-pounders, two 3-pounders, two 1-pounders, four 37-mm. Hotchkiss, two Colts, one field gun. **Authorized** 1886.

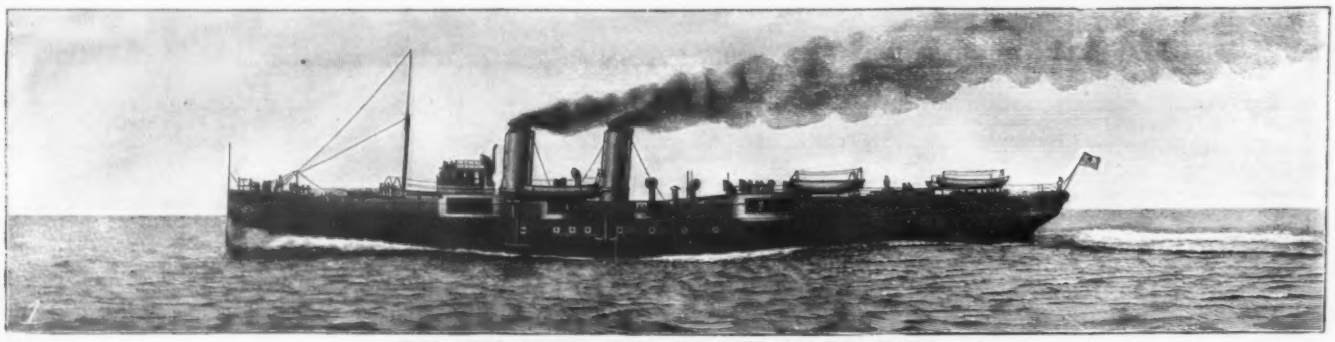
PROTECTED CRUISER "BALTIMORE."

It is just now a fact of special interest that the "Baltimore," at present stationed at Honolulu, was built from plans which were originally offered by the Armstrong Company in competition for the construction of a cruiser for the Spanish government. They were purchased by the United States government and the contract to construct the ship was let to the Cramp Company, who, after making several changes in the plans, turned out the handsome and very successful protected cruiser "Baltimore." She was authorized in 1886 and went into commission January 7, 1890. The contract called for 9,000 horse power, to be maintained for four hours, and offered a premium of $100 for every additional horse power. The Cramps gave in this vessel the first indication of their ability to largely exceed the contract horse power and speed in ships built at their yards, for the "Baltimore" indicated 10,064 horse power and maintained an average speed for five hours of 20·1 knots, thereby winning for the firm a bonus of over $100,000.

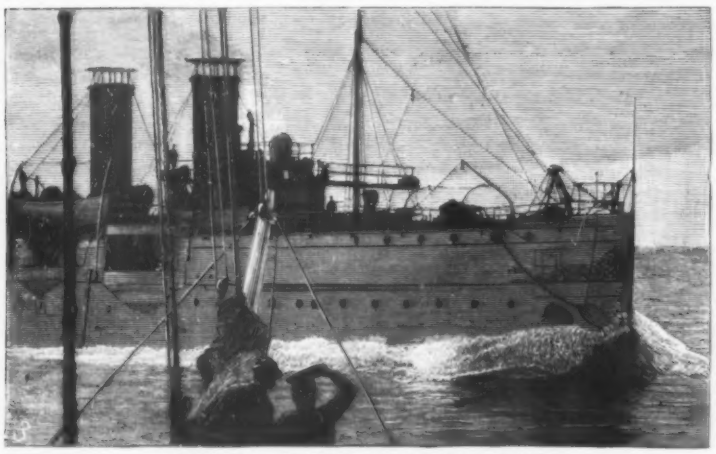


PROTECTED CRUISER "SAN FRANCISCO" AS COMPLETED.

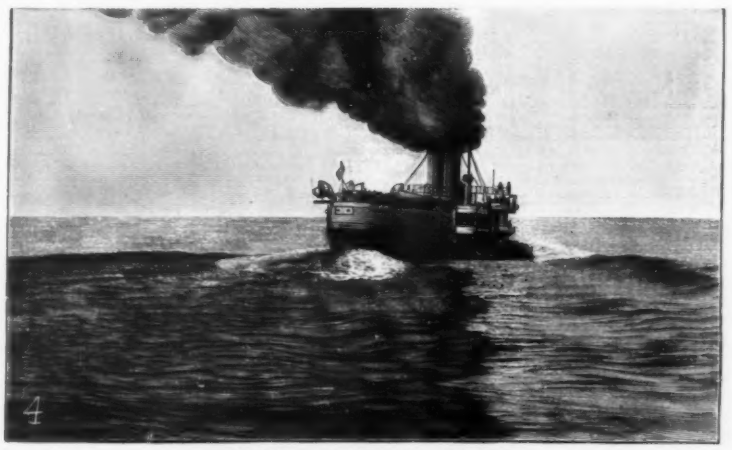
The displacement of the "Baltimore" is 4,413 tons, as compared with 3,730 tons for the "Charleston," and the extra 683 tons has been turned to good account. She carries four 8-inch guns in place of the two carried by the "Charleston," and these are placed some 8 feet higher above the water line, two forward upon a forecastle deck and two aft upon the poop. The six 6-



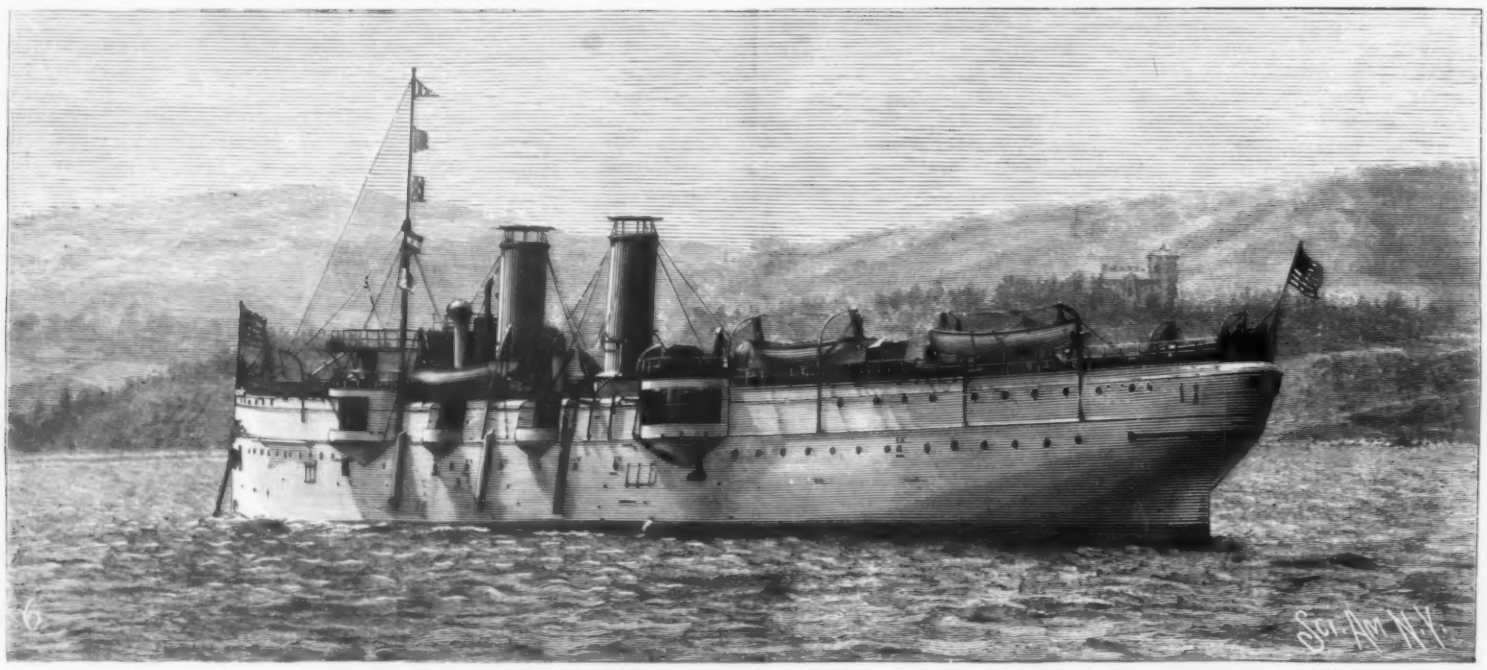
FULL SPEED DURING TRIAL TRIP—SHIP NOT YET RIGGED.



PASSING A STAKEBOAT—THE BOW WAVE.



WAVE-LINE SEEN FROM ASTERN.



PROTECTED CRUISER "SAN FRANCISCO"—AFTER THE TRIAL TRIP—RECORD 19·5 KNOTS.

Displacement, 4,098 tons. Speed, 19·5 knots. Maximum Coal Supply, 628 tons. Complement, 383. Armor: Protective deck, 2 in. on flat, 3 in. on slopes. Guns: Main battery, twelve 6-in. slow-fire; secondary rapid-fire battery, four 6-pounders, four 3 pounders, two 1-pounders, three 37-mm. Hotchkiss, four Gatlings, one field gun. Torpedo tubes, four. Authorized 1887.

inch guns are carried in the waist of the ship upon the gun deck in broadside. All the guns are sponsoned out on the beam and together they constitute a very powerful battery for a ship of this size. The liberal freeboard of the "Baltimore," the height at which she carries her guns, her speed and general serviceableness render her a popular ship in the navy. When her six 6-inch slow-fire guns are replaced by 5 or 6-inch quick-firers, she will compare favorably with ships of a later date.

The protective deck is 2½ inches on the flat and 4 inches on the slopes, as against 2 inches and 3 inches in the "Charleston." She carries a crew of 386 men, as against 306, and her bunker capacity is 1,144 tons, as against 758 tons in the smaller ship. A notable service performed by the "Baltimore" was the transfer of Ericsson's body from the United States to its resting place in Sweden, the great inventor's native land.

PROTECTED CRUISER "SAN FRANCISCO."

The protected cruiser "San Francisco" and her sister ship the "Philadelphia" were authorized in 1887, the former being built at the Union Iron Works and the latter by the Cramps. The points of difference in the boats are given in the following table:

	Length.	Beam.	Draught.	Displacement.	Speed	Bunker Capacity
San Francisco	310 ft.	49 ft. 2 in.	18 ft. 9 in.	4,098	19·53	628 tons
Philadelphia..	327 ft. 6 in.	48 ft. 7⅛ in.	19 ft. 2⅛ in.	4,324	19·68	1086 tons

The contract for both ships called for a speed of 19 knots, and a premium of $50,000 was offered for each ¼ knot above this, a deduction of a like amount to be made for every ¼ knot by which the ships failed to reach the contract speed. The engines were of the horizontal triple-expansion type, the Cramps designing the engines of the "Philadelphia" and those of the "San Francisco" being built from government plans. Each ship won a premium of $100,000 for the contractors.

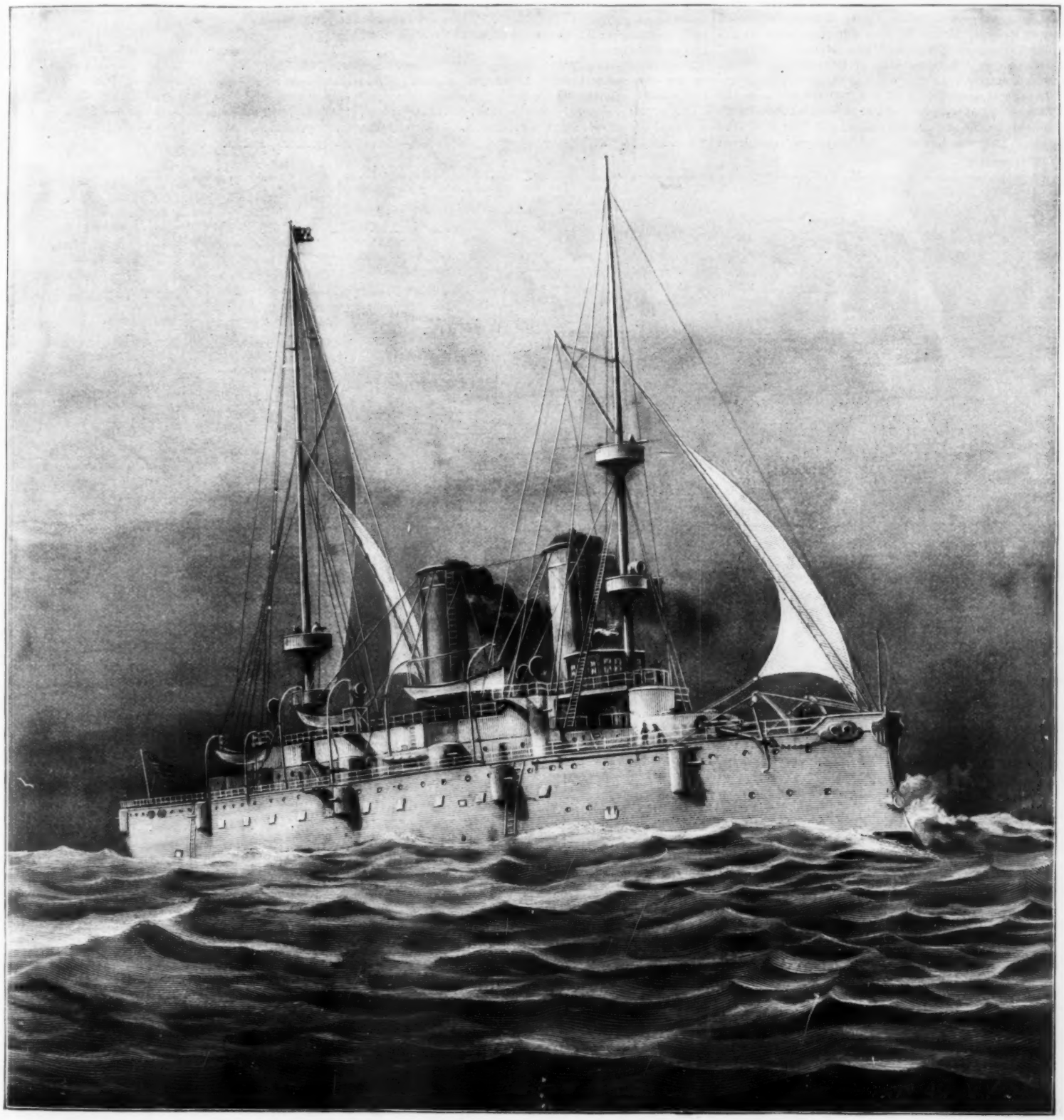
The armament of the two ships is identical. The main battery consists of twelve 6-inch slow-fire guns. Two of them are mounted on the forecastle deck, two on the poop and four are ranged in broadside on the gun deck. Both ships carry their guns well above the water, and when they have been rearmed with quick-firers, as no doubt they soon will be, they will compare favorably in fighting power and speed with later ships. The steel deck in the "Philadelphia" is from 2½ to 4 inches thick and in the "San Francisco" from 2 to 3 inches.

The trial trip of the "San Francisco" took place before the masts were stepped or the guns mounted. The engraving at the top of page 22 shows the vessel as finally completed. Those taken during the trial trip are of special interest, as showing the curious wave line formed when the ship was running at full speed.

PROTECTED CRUISER "OLYMPIA."

The "Olympia," 5,870 tons, has been called a smaller edition of the "New York," 8,200 tons; and it is true that in armament, speed and handsome appearance there is a certain likeness. It must be remembered, however, that they are not of the same type, the "Olympia" having no side armor and, therefore, coming in the class of protected ships.

There is a certain respect in which the "Olympia" can easily challenge comparison with any other protected cruiser, either in our own or in any other navy of the world. We doubt if there is any protected ship which can show on a given displacement so high a development of the various qualities which go to make up the efficiency of this type of warship. The genius



PROTECTED CRUISER "OLYMPIA."

Displacement, 5,870 tons. **Speed**, 21·7 knots. **Maximum Coal Capacity**, 1,170 tons. **Complement**, 450. **Armor:** Protective deck, 2 in. on flat, 4¾ in. on slopes. **Guns:** Main battery, four 8-in., ten rapid-fire 5-in.; secondary rapid-fire battery, fourteen 6-pounders, seven 1-pounders, four Gatlings, one field gun. **Torpedo tubes**, five. **Authorized** 1888.

of the naval designer will be shown in the manner in which he distributes his weights; and the most successful ship will be that which secures a high all-around efficiency without the sacrifice of any one essential feature. It would be an easy matter, comparatively, to build a ship which should be at once the fastest, best protected, most heavily armed, and have the greatest coal endurance of any ship in the world—provided there were no limit upon displacement. The "Columbia" can steam 23 knots against the "Olympia's" 21·68 knots; but to get this 1½ knots of extra speed she has had to sacrifice her offensive power to such an extent that she would be an easy prey to the smaller ship in a naval duel. Judged by the ships which have lately been produced, the United States designers are considerably ahead of those of foreign navies in their ability to turn out ships with an all-around efficiency. A comparison of the "Olympia" with the new "Eclipse" class of British cruiser, built from government designs, will show this very clearly.

The great superiority of the "Olympia" over the "Eclipse" on every point of comparison cannot be attributed to the extra 200 tons displacement of the former. The main battery of the "Olympia," composed

	Displacement.	Horse power.	Speed.	Protective deck.	Normal coal carried.	Armament.
	Tons.			Inches.		
"Olympia"..... ..	5,870	17,313	21·68	4½ to 2	400	Four 8-in., ten 5-in. quick fire, fourteen 6 pounders, 12 light guns.
"Eclipse"..... ..	5,600	9,600	19·5	3 to 1½	550	Five 6-in. quick fire, six 4·7 in. quick fire, eight 3-in. quick fire, six light guns.

of four 8-inch and ten 5-inch breech-loading rifles, is entirely on the main deck. The four 8-inch guns are mounted in pairs in two turrets of Harveyized steel 3½ inches thick, revolving within barbettes of 4-inch nickel steel armor. Firing through an arc of 208 degrees and having an axial height of 22 feet, these guns have a great range of action, besides being unusually well protected from return fire.

The ten 5-inch guns, which are of the rapid-fire type, are housed in armored sponsons 4 inches thick, and are so placed that they give a direct bow or stern fire from four guns and a broadside discharge on either side from five.

The secondary battery, composed principally of fourteen 6-pounder rapid-fire guns, is stowed in armored sponsons on the gun deck and along the hammock berthing above the 5-inch guns, affording the greatest convenient range and command. The disposition of the 6-pounders on the berth deck is such that, while free from the flash of the main battery above, they may maintain a complete belt of fire around the ship. The seven 1-pounders and the four Gatling guns, which constitute a minor phase of the secondary battery, are distributed in the fighting tops and at advantageous points on the bridges. There are six torpedo discharges; one at the bow, one at the stern and two on each broadside.

The vessel has twin screws, each shaft being driven by its own vertical triple-expansion engine. While not admitting strictly of comparison, the "Olympia" and the "Minneapolis" have engines individually alike, one having two sets and the other three. On trial, the "Minneapolis" developed nearly 21,000 horse power, a proportion of 7,000 for each engine; and the "Olympia" developed 17,313—over 1,600 horse power more in each engine than was realized by the larger craft. The "Olympia" was built by the Union Iron Works, and since her commission has done duty in Pacific waters. She is now the flagship at Hong Kong.

UNPROTECTED CRUISER "DETROIT."

The three unprotected cruisers "Detroit," "Marblehead" and "Montgomery" were authorized in 1888. The first and last were built at the Columbian Iron Works, Baltimore, and the "Marblehead" at City Point Works, Boston.

Unprotected cruisers rely solely upon coal and a very minute subdivision of the compartments in the region of and below the load line for protection against serious injury. This is further secured by cofferdams worked in the vicinity of the machinery spaces and filled with cellulose or other water-excluding material to prevent the water, in case of injury, from finding its way to the larger compartments in the center of the vessel.

All the machinery, dynamos and magazines are placed beneath a watertight deck of thin plating, which at its outboard ends is some three feet beneath the water line, but rises considerably above it in the central portions. The object of this deck is not so much to afford resistance to a shot from an enemy, but to allow the side of vessel to be pierced near the load line, or even below it, without flooding the compartments containing the boilers, engines and magazines. The dimensions are as follows: Length, 257 feet; beam, 37 feet; draught, 14 feet 7 inches; displacement, 2,089 tons.

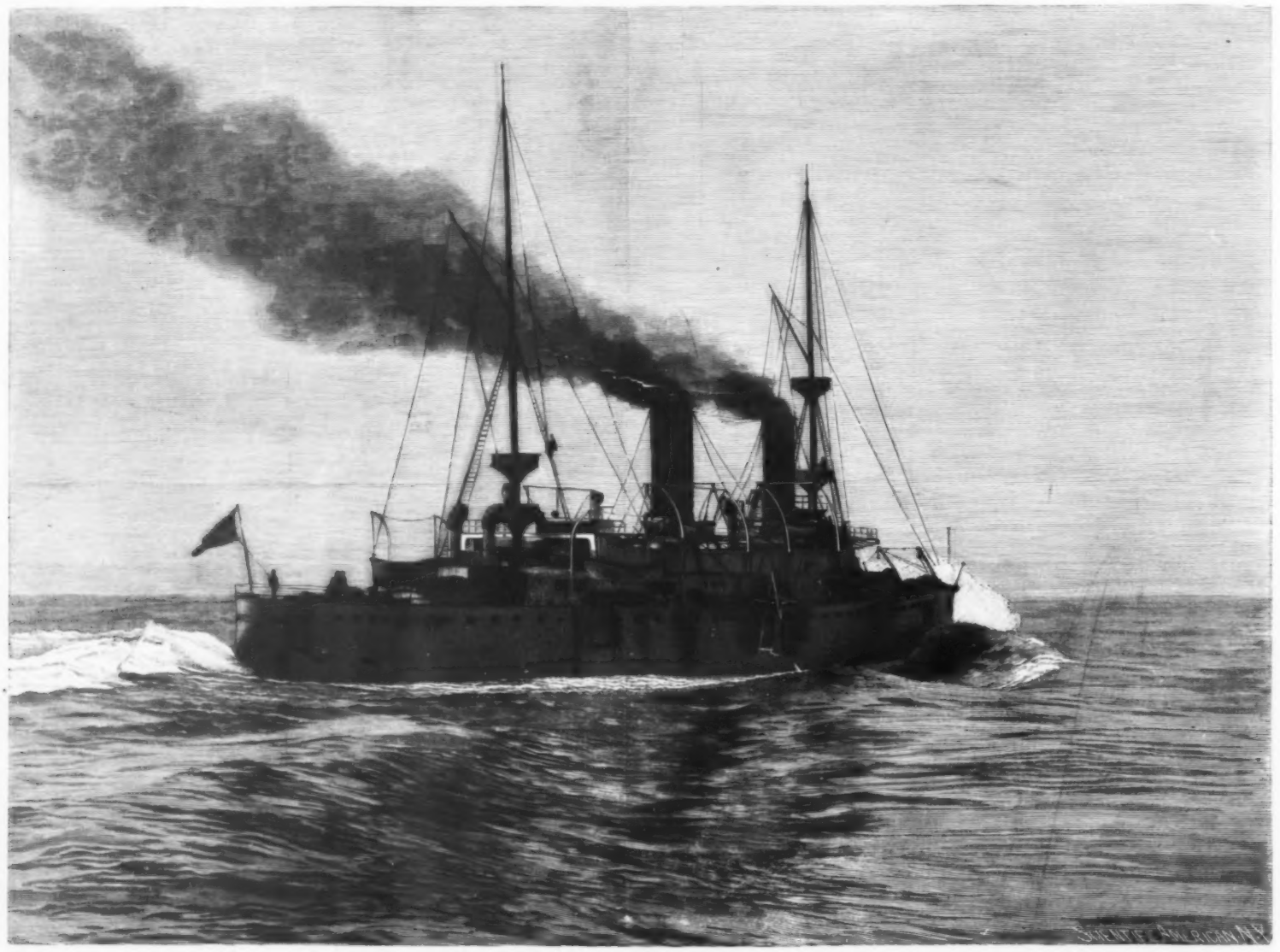
The armament of ten 5-inch rapid-fire guns is carried as follows: One each on the forecastle deck and the poop, two in wide sponsons on each broadside, giving dead ahead and astern fire, and between these are two other 5-inch guns on each broadside. The trial speed of the "Detroit" was 18·71 knots. As these boats are intended for long cruises on distant stations, they are furnished with specially roomy accommodation for officers and crew.

PROTECTED CRUISER "NEW ORLEANS."

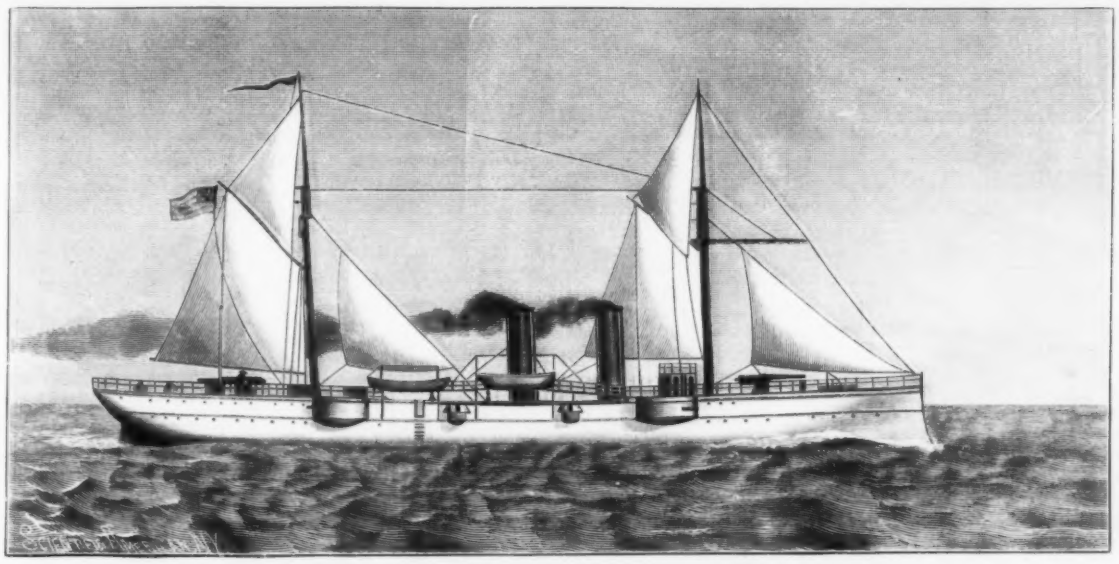
The "New Orleans," formerly the "Amazonas," of the Brazilian navy, is one of two vessels recently purchased by the government from Brazil. The sister ship, which is not yet completed, will be known as the "Albany." These vessels were ordered from the Armstrong Company, Newcastle, England, by the Brazilian government, and at the time of their purchase the "Amazonas" was in commission and about to sail for Brazil.

The "New Orleans" is a typical boat of the kind turned out by the builders, and exhibits the characteristic qualities of good speed and abnormally heavy battery, comparing in this respect with our own "Cincinnati." The principal dimensions, etc., of these twin ships are as follows: Length, 330 feet; beam, 43 feet 9 inches; draught, 16 feet 10 inches; displacement, 3,600 tons. They have twin screws and engines, the horse power being 7,500 and the speed 21·05 knots. Their normal coal supply is 700 tons, though they have stowage room for more. They are protected by a Harvey steel deck which is 3 inches thick where it curves down below the water line along the sides.

The battery is, for the size of the ship, very powerful. It is not only powerful in numbers, but owing to the fact that its guns are of the latest pattern, they have vastly greater power for their size than guns that were built only four or five years ago. Armstrongs are builders of both the wirewound and the hooped types of gun, and [illegible]apons turned out by this firm have shown very high ballistic results. Not only are these guns more powerful for their weight, but they have



THE "OLYMPIA"—MAKING 22·26 KNOTS.



UNPROTECTED CRUISER "DETROIT."

Displacement, 2,089 tons. **Speed**, 18·7 knots. **Maximum Coal Supply**, 340 tons. **Complement**, 256. **Armor:** ⅜-in. watertight deck. **Guns:** Main battery, ten 5-in. rapid-fire; secondary rapid-fire battery, six 6-pounders, two 1-pounders, two Colts, one field gun. **Torpedo tubes**, two. **Authorized** 1888.

improved breech mechanism which enables them to be fired with greater rapidity. The following comparison of the "New Orleans" with a ship of the same size and type built for the British navy from government plans shows clearly the greater fighting power of the former. The figures are taken from the official tables of the British navy and the firm of builders. The speed of fire is that actually obtained by crews on board ships in commission. The "Intrepid" is one of a class of thirty ships built under the late Naval Defense Act, and though not so up-to-date as the "Amazonas," may be considered as a good example of the average protected cruiser of the existing navies of the world.

COMPARISON OF TOTAL ENERGY OF FIRE DURING ONE MINUTE FROM EITHER BROADSIDE.

	Number and Size of Guns.	Muzzle Energy.	Shots per Minute from Each Gun.*	Total Energy.
"New Orleans" ("Amazonas") 1897	Four 6-inch.	4,840 foot tons	6	116,160
	Two 4·7-inch.	2,158 " "	12	51,792
	Five 2·24-inch.	280 " "	20	28,000
				195,952
"Intrepid," 1892	Two 6 inch.	3,356 " "	5	33,560
	Three 4·7-inch.	1,494 " "	10	44,820
	Four 2·24-inch.	137 " "	20	10,960
				89,340

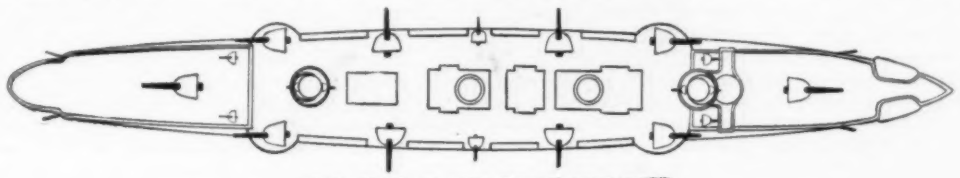
* This rapidity of fire would not of course be maintained for any length of time in the excitement and slaughter of a modern sea fight. The figures, however, serve for the present comparison.

From this comparison then it is evident that although the two ships are of the same size, the "New Orleans" can deliver from her broadside more than double the energy of shell fire that the "Intrepid" can, although the latter ship was built only five years in advance of the former—such is the rapidity with which naval science and construction advances. The increased energy is due to increased velocities resulting from the greater length of the guns and the use of improved powders.

As further illustrating the development in naval design in a brief five years, we append below a further comparison.

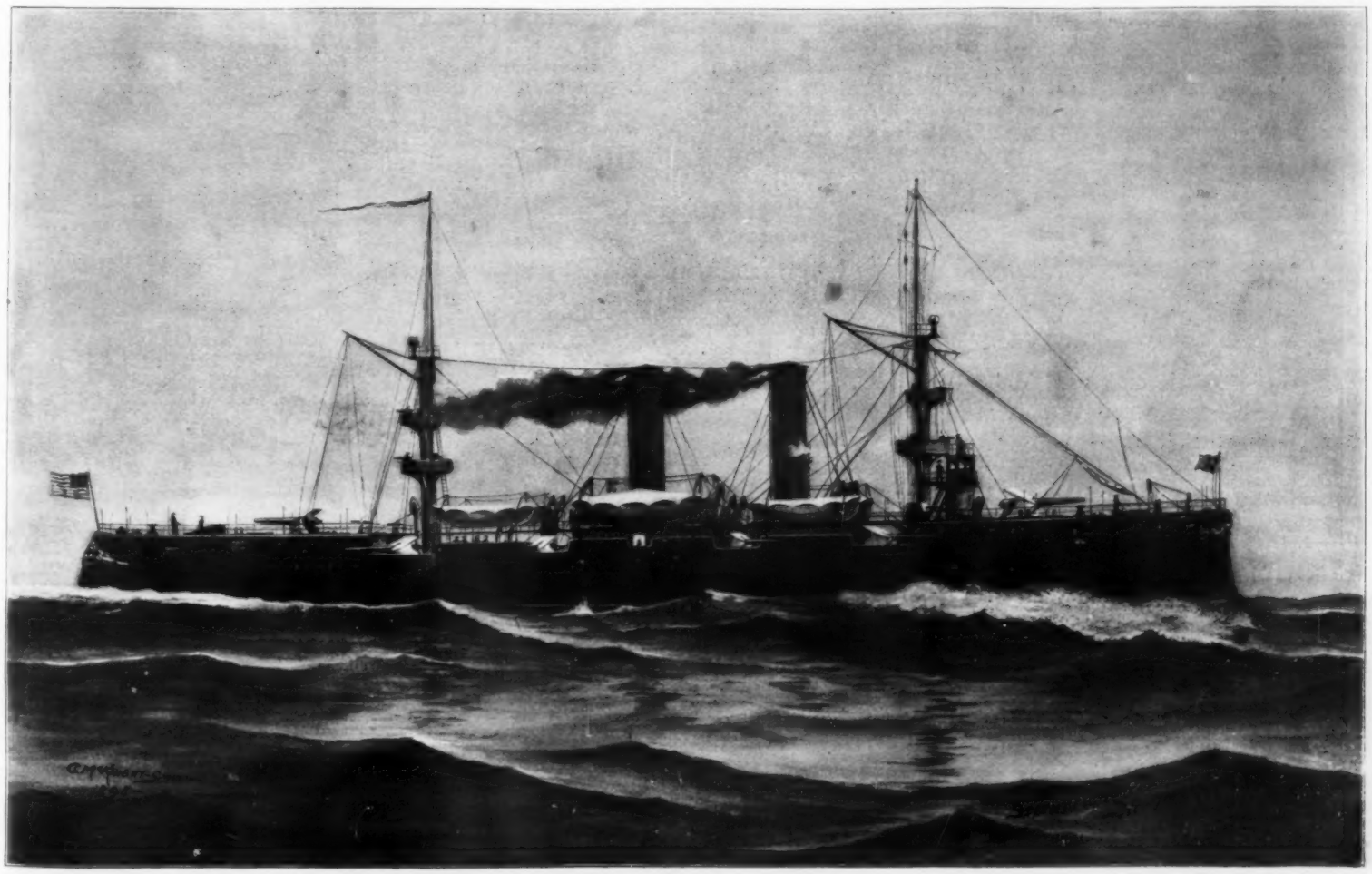
We find, then, that by the use of improved materials and methods the naval architect has been able, out of the same capital (3,600 tons displacement) to produce a ship having superiority on every point of comparison—a ship with more speed, with 50 per cent better protection, 80 per cent larger coal capacity, and over 100 per cent more powerful armament.

The transfer of the ship took place at Gravesend, at the mouth of the Thames, England, when the ship was formally handed over by Commander Corres, of the Brazilian navy, to Lieut. Colwell, of the United States navy. The Brazilian flag was hauled down and the stars and stripes were run up, accompanied by a salute from the old fort at Tilbury, whose guns had not spoken for two centuries past.



DECK PLAN OF THE "NEW ORLEANS."

	Thickness of Deck.	Horse Power.	Speed.	Coal Capacity.
"New Orleans"	3 inches.	7,500	20·00	700
"Intrepid"	2 "	9,000	19·75	400

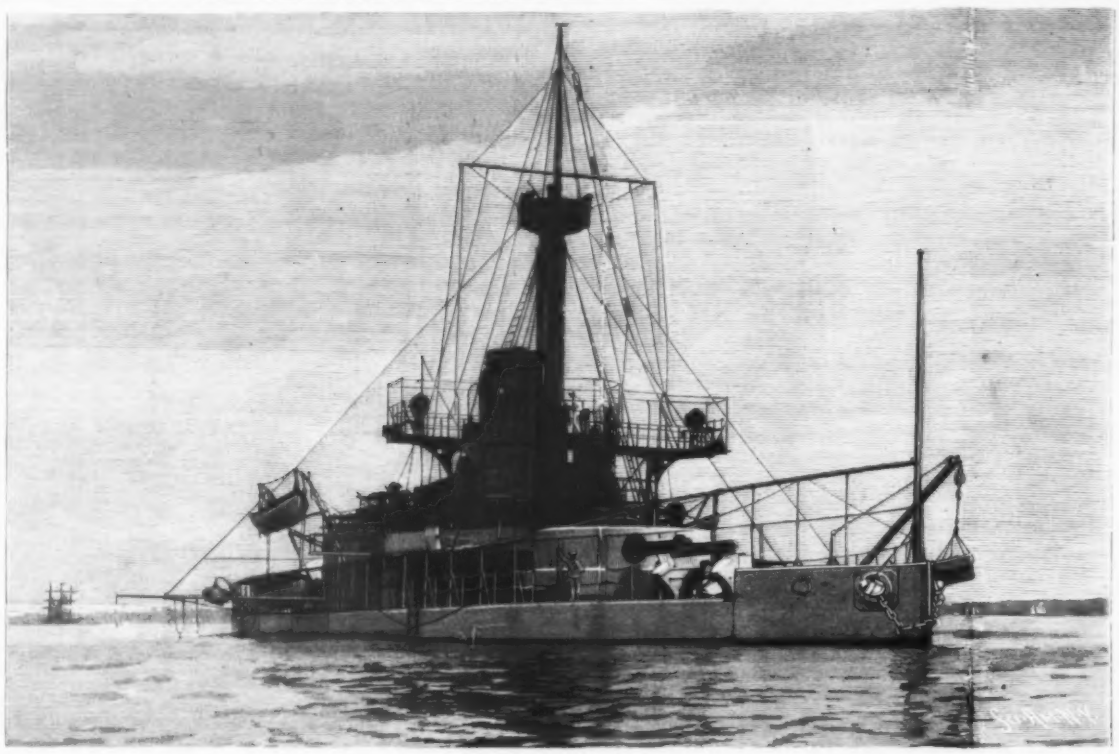


PROTECTED CRUISER "NEW ORLEANS" (FORMERLY "AMAZONAS.")

Displacement, 3,600 tons. **Speed**, 21·05 knots. **Normal Coal Supply**, 700 tons. **Complement**, 350. **Armor:** Protective deck, 3 in. on slopes. **Guns:** Main battery, six 6-in. rapid-fire, four 4·7-in. rapid-fire; secondary rapid-fire battery, ten 6-pounders, four 1-pounders, four machine guns. **Torpedo tubes**, three. **Purchased from Brazil** 1898.

MONITORS.

THE monitors of our navy form a connecting link between the early and later systems of armored warship construction. They embody in their original design the lessons which had been learned in the naval operations of the civil war, and, as their name implies, they are modeled after the pattern of Ericsson's famous "Monitor." The chief characteristics of this type of ship are moderate speed, low freeboard, making them a difficult object to hit, thick armor, and an armament of a few exceptionally heavy guns. Sitting low in the water, they are not suited for work on high seas, and their sphere of operations lies within sheltered waters, such as are found in our bays and harbors. This is their proper sphere of action, and to enable them to maneuver in shoal waters they are designed to have as little draught as possible. Strictly speaking, they are floating batteries, and as such they are intended to co-operate with the land batteries in defense of our coasts. But though the monitor is designed specially for harbor defense, it would be quite capable of taking part in a fleet action off the coast in ordinary weather.



MONITOR "AMPHITRITE."

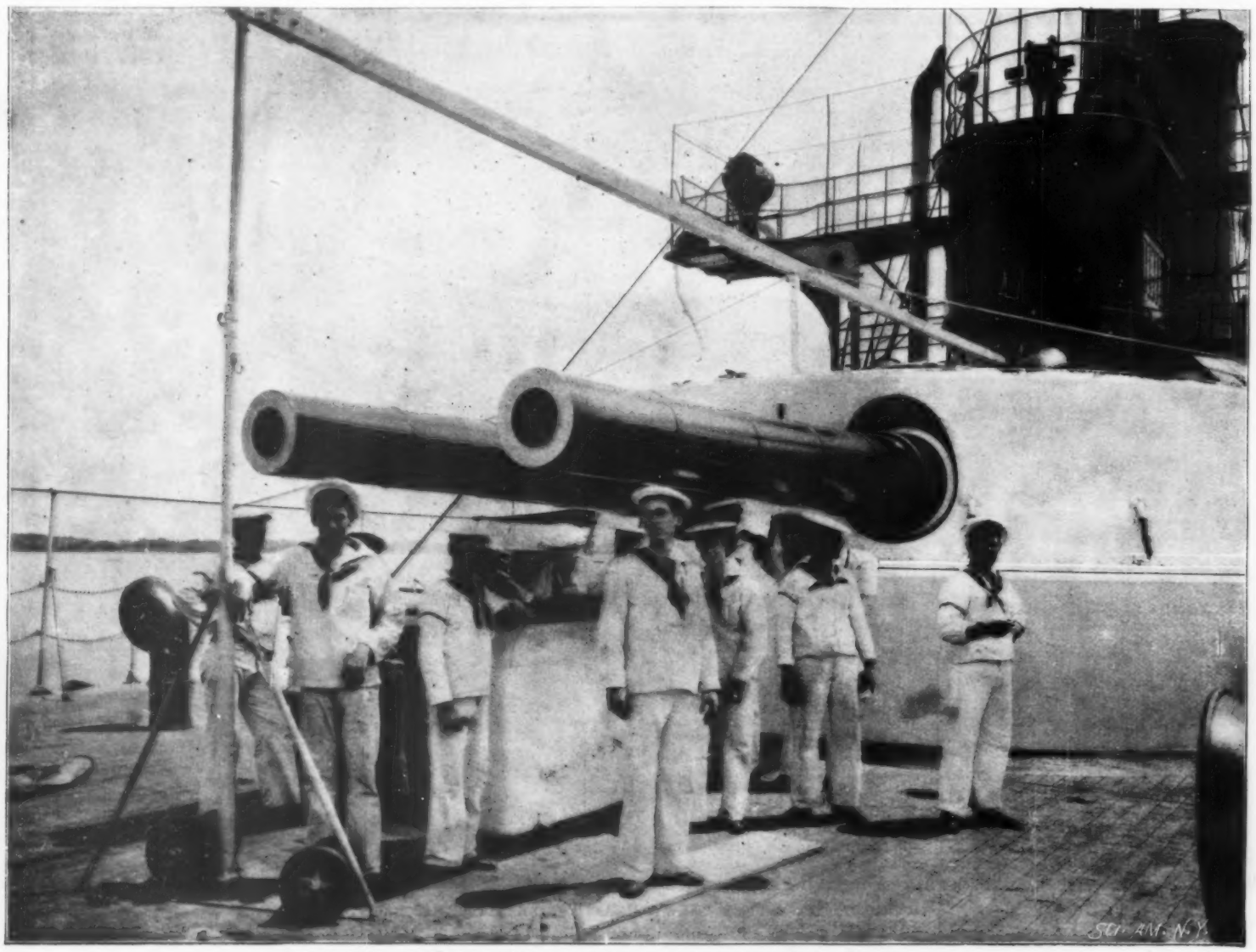
Displacement, 3,990 tons. **Speed**, 10·5 knots. **Maximum Coal Supply**, 250 tons. **Complement**, 182. **Armor:** Deck, 1¾ in.; sides, 5 to 9 in.; barbettes, 11½ in.; turrets, 7½ in. **Guns:** Main battery, four 10-in., two rapid-fire 4-in.; secondary rapid-fire battery, two 6-pounders, two 3-pounders, two 37-mm. Hotchkiss, two 1-pounders. **Keel laid** 1874. **Completion authorized** 1885.

MONITOR "AMPHITRITE."

The formidable little warship which forms the subject of the accompanying illustrations is one of a group of five similar vessels whose keels were laid as far back as the year 1874. In the official lists of the navy they are described as iron low-freeboard coast-defense monitors. With the exception of a few small gunboats, they represent the only new construction attempted in the navy during that long twenty years intervening between the close of the civil war and the date of the construction of our modern navy. The building of even these five ships was carried on slowly, and it was stopped before they were completed. The shells of the ships, with their engines on board, but with no armor or armament, were laid up, and it was not until March 3, 1885, that an appropriation of $3,178,046 was made for their completion.

Of the five monitors, three, the "Miantonomoh," "Monadnock" and "Terror," are sister ships to the "Amphitrite," which is of 3,990 tons displacement, the "Puritan" being considerably larger, 6,060 tons, and carrying 12 inch, against the 10-inch guns of the smaller ships. There is another monitor, the "Monterey," similar in design but more modern in construction, which was built by the Union Iron Works, at San Francisco, and is now stationed on the Pacific coast.

The hull of the "Amphitrite" is built of iron. It is constructed on the cellular system, and the double bottom rounds up into the sides to within 3 feet of the water line, where it forms a shelf on which is carried the armor belt. This is 7 feet high, and reaches to the



COAST DEFENSE MONITOR "AMPHITRITE"—THE FORWARD PAIR OF 10-INCH GUNS.

main deck, 4 feet above the water line. The belt tapers in thickness from 9 inches amidships to 5 inches at the ends. The main deck is of 1¾-inch steel, overlaid with wood. The barbettes and turrets are of Harvey steel, with a thickness of 11½ and 7½ inches respectively. The roof of the turret is plated with 1½-inch steel. The conning tower is of 9-inch Harvey steel. It stands just abaft the forward turret. Immediately above it is the chart house, and above this the flying bridge. Between the two turrets is the superstructure, which carries upon its deck two 4-inch rapid-fire guns, two 6-pounders, two 3-pounders, and two 1-pounder rapid-fire guns. We give two illustrations of the 4-inch guns, which, although they are of comparatively small size, are among the most effective and handy weapons in the navy. They are mounted on steel carriages which rotate on a circle of rollers, carried by a cast steel pedestal which is itself firmly bolted to the deck. A semicircular shield 2 inches thick is attached by brackets to the top carriage and rotates with the gun. The shield reaches well down over the pedestal and affords full protection to the gun mount and the crew. The gun, carriage and shield are so evenly balanced that the piece can be trained and elevated with the greatest ease. The illustration taken from the rear shows the breech mechanism, the recoil cylinder beneath the gun and the sights. The training is effected by the crank wheel at the side and the elevation by the worm and pinion, which can be seen in the side view of the gun.

SIGHTING A 4-INCH RAPID-FIRE GUN.

The main fighting power of the "Amphitrite" lies in her four big 10-inch guns, which are mounted in pairs within the main turrets. This gun weighs 25 tons and fires a 500-pound shell at a velocity of 2,000 feet per second. It can penetrate 18·75 inches of steel at the muzzle, 16·82 inches at 1,000 yards and 15 inches at 2,000 yards.

The "Amphitrite" is driven by the original twin screw engines designed in 1870. They are of the direct acting inclined compound type, and the arrangement of the cylinders and cranks is very interesting as showing how the designers contrived to stow away such large machinery below the level of the protective deck. The cylinders which drive the port propeller shaft are located above the starboard shaft, and vice versa, the engines thus crossing each other diagonally. They are of 1,600 indicated horse power, and will drive the "Amphitrite" at a speed of 10·5 knots per hour. She carries a complement of 182 all told.

MONITOR "TERROR."

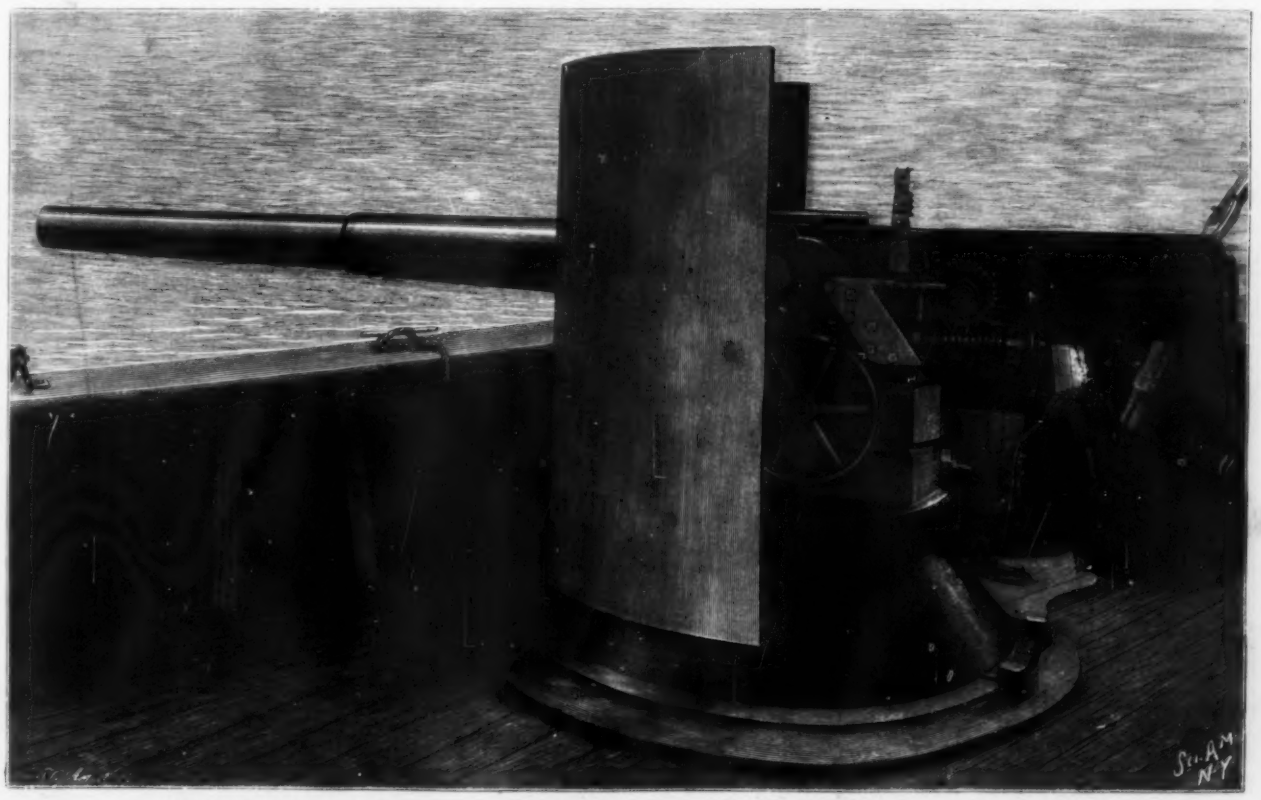
The monitor "Terror" differs from the "Amphitrite" in having no barbettes, the turrets projecting directly above the main deck. In this respect both she and the "Monadnock" are inferior to the "Terror," "Puritan" and "Monterey," which have an increased command for their guns, due to a low barbette.

There has lately been installed on the "Terror" a compressed air system for loading and manipulating the guns and steering the ship, which is spoken of very favorably in the last report of the Secretary of the Navy.

The use of compressed air as a motive power on board a warship presents several advantages over steam or hydraulic power which render it a powerful competitor. As compared with steam, it is less dangerous, especially during an action, when a broken steam pipe might prove terribly fatal, and it enables certain parts of the ship to be kept at an even temperature, which would otherwise be rendered uncomfortably hot by the presence of steam piping. Steam and hydraulic engines, moreover, require exhaust pipes discharging outside the hull of the ship; whereas the exhaust from the pneumatic cylinders may be turned into the ship or into the outside air, as may be most convenient. There are certain localities in a ship where the exhaust from a pneumatic engine would prove a valuable source of ventilation, as, for instance, in a turret crowded with men and machinery, or in the close confinement of a steering room situated below the protective deck. As compared with hydraulic power, the compressed air system is cleaner and more convenient, and free from the discomfort that arises from the leaking of hydraulic pipes and cylinders.

The air for driving the various pneumatic devices is compressed by two separate engines, which supply sufficient air for turning the turrets, elevating the guns, lifting the ammunition into the cages, raising the cages to the breech of the gun, ramming home the charge, closing the breech, checking the recoil, and lastly, and most important operation of all, steering the ship itself.

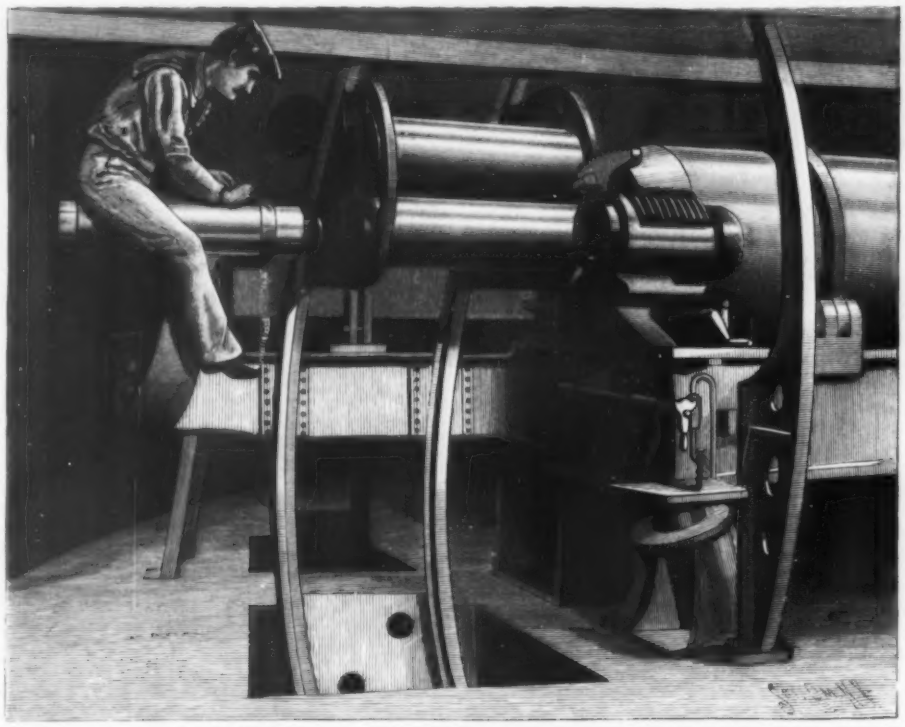
The two turning engines are placed upon the floor of the turret, one on each side of the big guns. Each engine has two cylinders, 8 inches in diameter by 14 inches stroke. A worm on the crank shaft operates a set of gears by which the power is multiplied many times over before it reaches a driving pinion, which, in common with the engine and gears, is firmly bolted to



FOUR-INCH RAPID-FIRE GUN WITH REVOLVING SHIELD—COAST DEFENSE MONITOR "AMPHITRITE."

the framing of the turret and of course turns with it. The pinion meshes with a large circular rack which is bolted to the deck of the ship and lies immediately within the circular steel track upon which the turret rotates. The engines are controlled by suitable levers and hand wheels situated within easy reach of the officer in the sighting hood, the latter being placed over and between the guns, as shown in the sectional view, page 29.

The elevation and depression of the gun is effected by means of a massive ram, which is hinged to the floor of the turret and bears against a shoe on the under side of the gun carriage near the breech of the gun. On each side of the turret is a cylinder containing glycerine and water, a portion of which, when the gun is to be elevated, is forced by compressed air into the ram, the supply being regulated by valves which are operated by means of levers in the sighting station above mentioned.

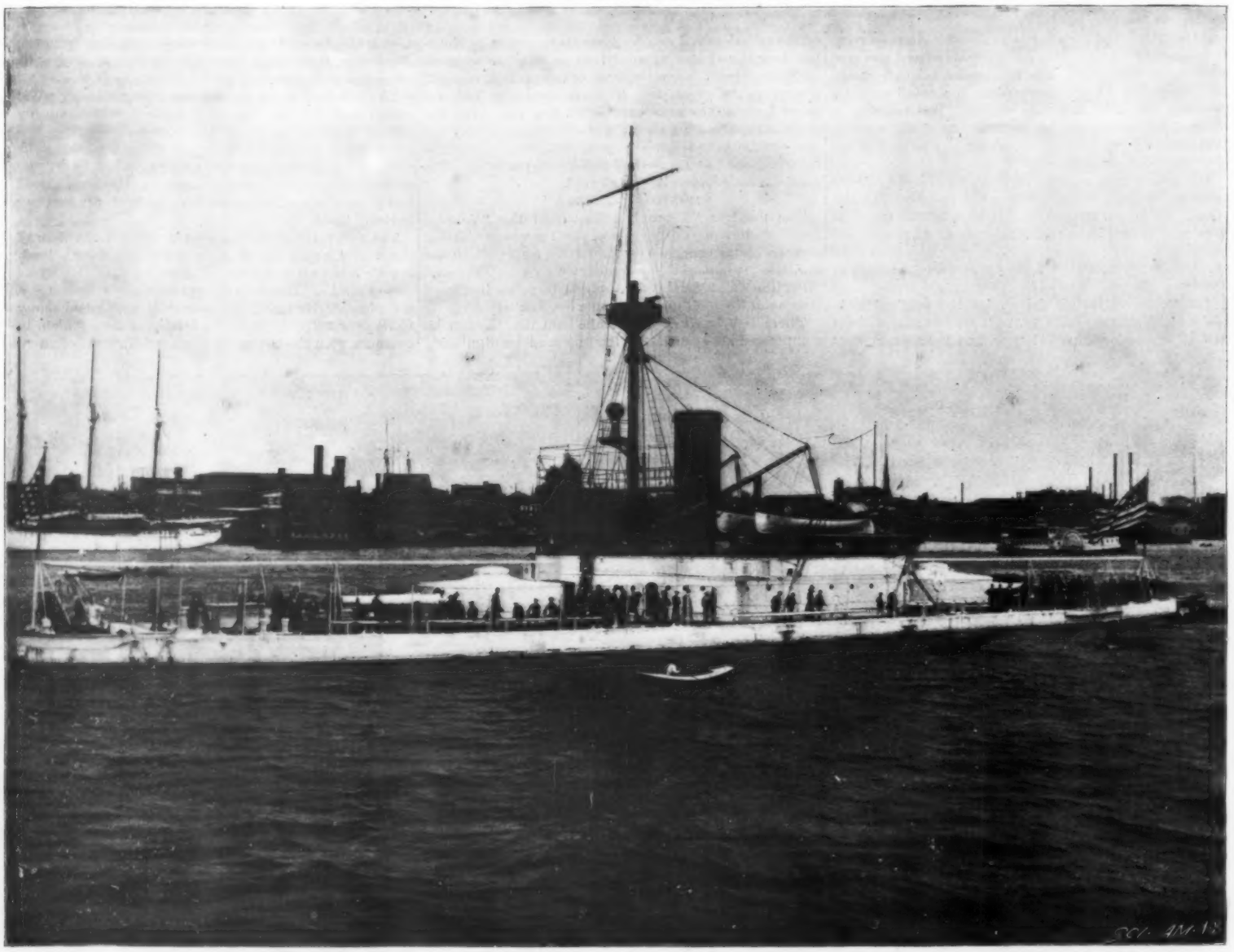


MONITOR "TERROR"—LOADING-CAR IN POSITION BETWEEN THE TELESCOPIC RAMMER AND THE BREECH OF THE GUN.

By reference to the large sectional view of the turret the reader can obtain a clear idea of the method adopted for sighting the great 10-inch guns. From the forward end of the massive gun carriage a small vertical rod is carried up to a bell-crank lever situated near the roof of the turret. Another rod extends from the short arm of the lever and is connected to another bell-crank lever attached to the sighting hood. The long arm of this lever carries a sighting telescope which is placed opposite one of the narrow horizontal slits which are cut through the side of the hood. The system of levers is so proportioned that the axis of the telescope and the axis of the gun will always be parallel, any change in the elevation or training of the gun being accompanied by a similar change in the position of the telescope. With his eye at the telescope and his hand upon the levers which control the air valves of the turning and elevating machinery, the officer brings the cross hairs of the telescope to bear upon the mark, and by pressing an electric button hurls a 500-pound steel projectile with unerring precision at the hostile ship.

Immediately below the turret is the handling room, adjoining which are the magazine and the shell rooms, with which it communicates through doorways which, when not in use, are closed by watertight doors. Directly below the center of the turret is a pneumatic loading machine, which rotates upon a vertical shaft, and may be swung to the right or left as desired. The 500-pound shell and the cartridge, the latter in two parts, are run out from their respective rooms on an overhead trolley and placed in the tray of the loading machine, as shown in the illustrations. The tray is pivotally attached to the body of the machine by a set of parallel rods and a lever which carries at its inner end a circular rack. Above the rack is an air cylinder whose piston rod terminates in a vertical rack which engages the circular rack before mentioned. By admitting air at the top of the cylinder, the tray with its load is raised to the required height and the latter is placed in the pockets of the loading car.

There are two of these cars, one for each gun, and they

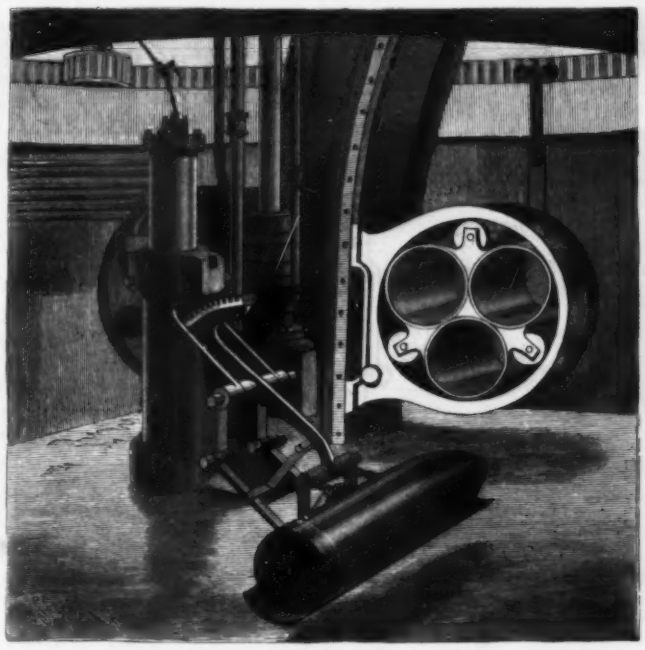


MONITOR "TERROR."

Displacement, 3,990 tons. **Speed**, 10·5 knots. **Maximum Coal Supply**, 250 tons. **Complement**, 177. **Armor:** Belt, 7 in.; deck, 1¾ in.; turrets, 11¼ in. **Guns:** Main battery, four 10-in.; secondary rapid-fire battery, two 6-pounders, two 3-pounders, two 37-mm. Hotchkiss, two 1-pounders, two Gatlings. **Keel laid** 1874. **Completion authorized** 1885.

travel upon two vertical hoists or trackways which lead up to the breech of the guns. The hoisting is done by two pneumatic cylinders located on the floor of the turret between the guns. By reference to the first illustration on this page, it will be seen that the loading car contains three parallel pockets, which rotate within the frame of the car, friction wheels being interposed to facilitate the movement. One of the pockets carries the shell and the other two the powder charge. The car is automatically brought to a stop with the lowest pocket containing the shell immediately in line with the breech of the gun.

The shell is pushed home by a telescopic rammer which is operated by compressed air, the valve which admits the air being worked by a man who sits astride of the cylinder. It will be noticed that the rammer is carried by a bracket bolted to an extension of the gun carriage, and it is consequently held at all times in true line with the bore of the gun. After the shell has been rammed home, the loading car is rotated and the two sections of the powder cartridge are brought successively opposite the breech and pushed home. The breech plug is then swung round, thrust into place and locked.



HANDLING ROOM OF THE MONITOR "TERROR"—PNEUMATIC LIFT FOR LOADING CHARGE INTO CAGE OF AMMUNITION HOIST.

The recoil of the gun is controlled by two pneumatic cylinders, 14 inches in diameter and 40 inches in length. The cylinders, whose heads can be seen in the smaller illustration, page 28, below the breech, are secured to the gun carriage and the pistons to the gun. Before firing, the pressure on the recoil side of the pistons is about 500 pounds per square inch. As the gun recoils, carrying the pistons with it, this pressure is rapidly increased by compression. To reduce the pressure at the end of the recoil, a tapered rod is provided, which passes through the center of the piston and allows the air to pass more and more freely to the counterside of the piston as the gun returns. The residual pressure is utilized to return the gun to its firing position. Perhaps there is no part of the many operations performed by compressed air on the "Terror" in which the power shows to better advantage—the elasticity of the air preventing all shock and providing an easy cushion in the recoil and counter recoil.

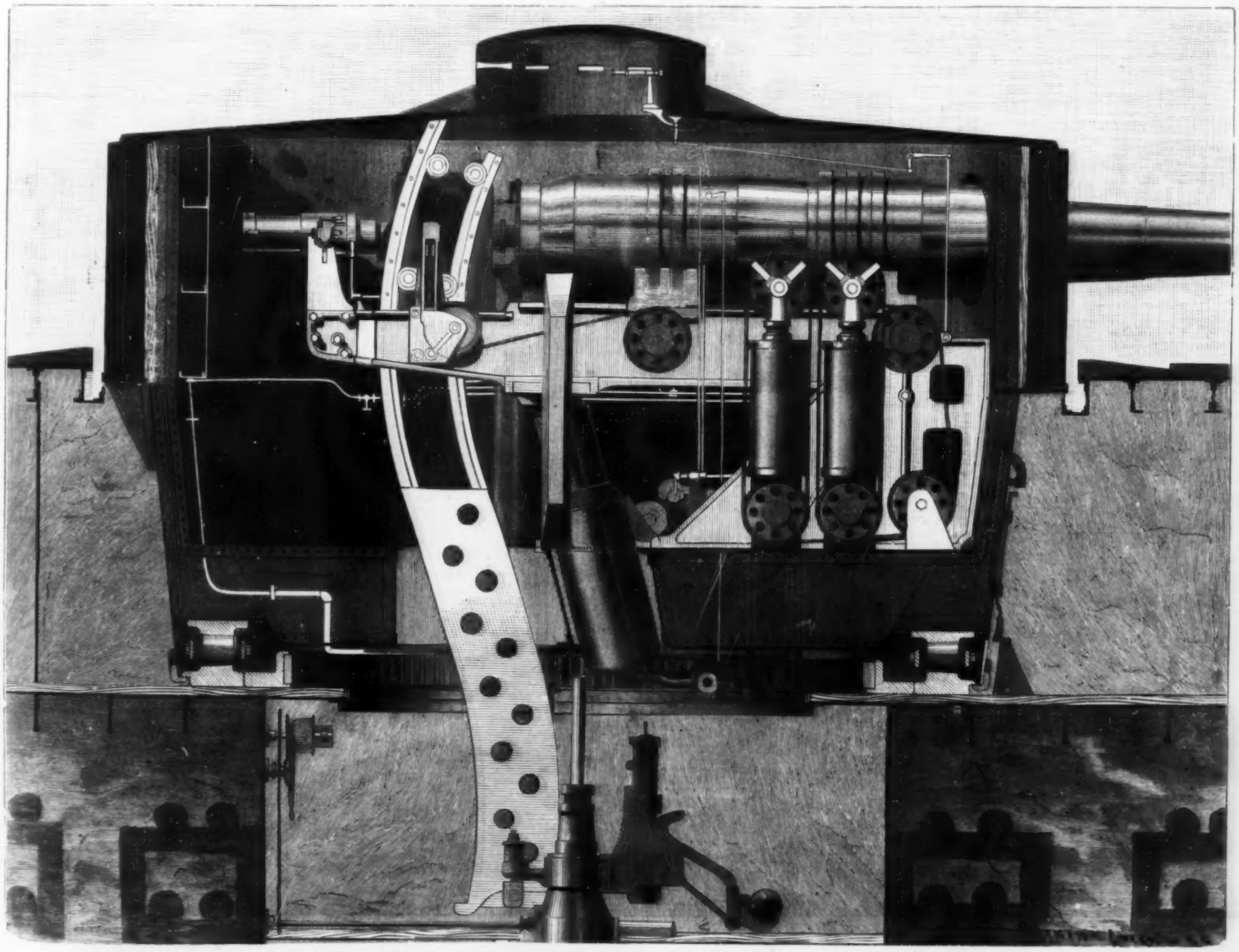
The last and most important duty performed by the compressed air is that of steering the ship. The interior of the steering room is shown on page 30. The work is performed by the two long horizontal cylinders which will be noticed arranged one on each side of the tiller. They are provided with a common piston rod, in the center of which is a hollow crosshead in which the tiller is free to slide as it is swung right or left by the movement of the pistons. Compressed air is admitted to the outer ends of the cylinders by means of a D valve, the air being simultaneously admitted at the back of one piston and exhausted from the other, according as the helm is to be put over to port or to starboard. Air is also admitted at all times at the inner ends of the cylinders, and a pipe connects them, so that, as the pistons move, the air may flow freely from the inner end of one cylinder to the inner end of the other. In the center of the connecting pipe is a bypass valve, which is open when the tiller is being moved, but closes when it has been traversed the desired angle and holds the air imprisoned in the cylinders, thus locking the tiller between two elastic cushions. The heavy shocks to which the tiller is subject in rough weather will thus be received and absorbed by the air, and the framing of the ship will be proportionately relieved of the strain.

For the constructive details of the hull and engines the reader is referred to the description of the sister ship "Amphitrite."

MONITOR "MONTEREY."

At the time when it was finally decided to complete the four old monitors whose keels were laid in 1874, the construction of a new monitor, the "Monterey," was authorized. The contract was secured by the Union Iron Works, San Francisco; the keel was laid in 1889, and the vessel went into commission February 13, 1893. While this powerful vessel is a monitor pure and simple, she embodies all the latest improvements in warship construction, and constitutes one of the most powerful coast defense vessels of the new navy.

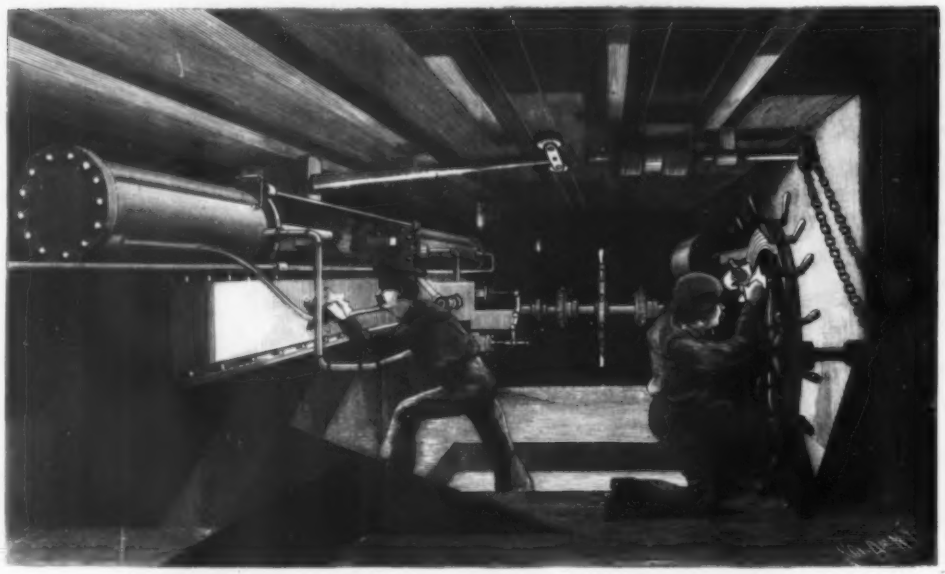
The principal dimensions etc., are: Length, 256 feet; beam, 59 feet; draught, 14 feet 10 inches. She is constructed entirely of steel, the belt is 13 inches thick amidships and tapers to 8 inches at the bow and 6 inches at the stern. A continuous deck of 3-inch steel extends from stem to stern. Further protection is afforded by a double bottom and watertight bulkheads, the hull containing 110 separate watertight compartments. The heavy guns are carried in turrets and the turning gear, etc., are protected by barbettes. Forward, the turret is 8 inches thick and the barbette 13 inches,



THE PNEUMATIC SYSTEM FOR MANIPULATING THE 10-INCH GUNS ON THE MONITOR "TERROR"—SECTIONAL VIEW OF ONE OF THE TURRETS.

and within the turret are two 12-inch guns. The after turret is 7½ inches and the barbette 11½ inches, the after guns being of 10 inches caliber. The ship carries a single military mast, in the fighting top of which is placed a part of the rapid-fire battery. The balance of the rapid fire guns are carried on the superstructure deck between the turrets.

We give two illustrations of the twin triple expansion engines, which indicated 5,244 horse power on the trial trip. The cylinders are 27, 41 and 64 inches diameter respectively and 30 inches stroke. The high pressure cylinder is forward in each engine, and has one piston valve 14 inches in diameter, the intermediate pressure cylinder having two of 14 inches and the low pressure cylinder two of 20 inches, all worked by Stephenson double-bar links. The cylinders are supported by cast steel inverted Y frames secured to cast steel bed plates. The crank shaft is of forged steel, in three interchangeable sections, with 4-inch axial holes through shafts and crank pins. The journals and crank pins are 11 inches diameter. The line, thrust and propeller shafts are 10 inches in diameter, with a 4-inch axial hole. The screw propellers, of manganese or aluminum bronze, are three-bladed, and are 10 feet 6 inches in diameter, the starboard one being right and the port one left handed.



PNEUMATIC STEERING APPARATUS ON THE MONITOR "TERROR."

The condensers are cylindrical, and have about 3,850 square feet of cooling surface in each. The circulating pumps are centrifugal, with a capacity of 5,000 gallons per minute each, and connections for working as wrecking pumps. Each condenser has two vertical single-acting air pumps, 14⅜ inches diameter by 15 inches stroke, driven by a compound engine with a fly wheel at each end of shaft. There is a valve in the exhaust pipe from each low pressure cylinder, to shut off the connection to the condenser and permit it to be used as an auxiliary condenser when the main engines are stopped. The engines are fitted with starting valves, a steam-actuated throttle, and a combined steam and hydraulic reversing gear, so that they can be handled with ease, and there are the usual auxiliary engines.

In order to reduce the weight of the machinery to the lowest limit, the engines have been made as light as possible, and about three-fourths of the required boiler power is supplied by coil or tubulous boilers. Four boilers of the latter class, to give a collective horse power of 4,500, were contracted for with Charles Ward, of Charleston, W. Va., after careful trials. The two cylindrical boilers with which the vessel is also to be supplied are fitted to work at 160 pounds, and are designed to give sufficient steam for ordinary uses, for propelling the vessel at 10 knots speed, while the coil boilers enable steam to be raised in less than half an hour in sufficient quantity to give the maximum speed of which the vessel is capable.

The illustration, below shows the "Monterey" in the new dry dock, on Puget Sound, Wash. The photograph was taken on the occasion of the opening of the dock on April 22, 1896.

MONITOR "MIANTONOMOH."

The keel of the "Miantonomoh" was laid by John Roach & Sons, at their works on the Delaware River, in 1874, and the hull was completed there. In many respects she represents a reproduction of the old wooden monitor "Miantonomoh." The present ship is built of iron, except as regards her armor plates, which are of steel. The general dimensions,

MONITOR "MONTEREY."

Displacement, 4,084 tons. **Speed**, 13·6 knots. **Maximum Coal Supply**, 236 tons. **Complement**, 195. **Armor**: Belt, 6 to 13 in.; deck, 3 in.; barbettes, 11½ and 13 in.; turrets, 7½ and 8 in. **Guns**: Main battery, two 12-in., two 10-in.; secondary rapid-fire battery, six 6-pounders, four 1-pounders, two Gatlings. **Authorized** 1887.

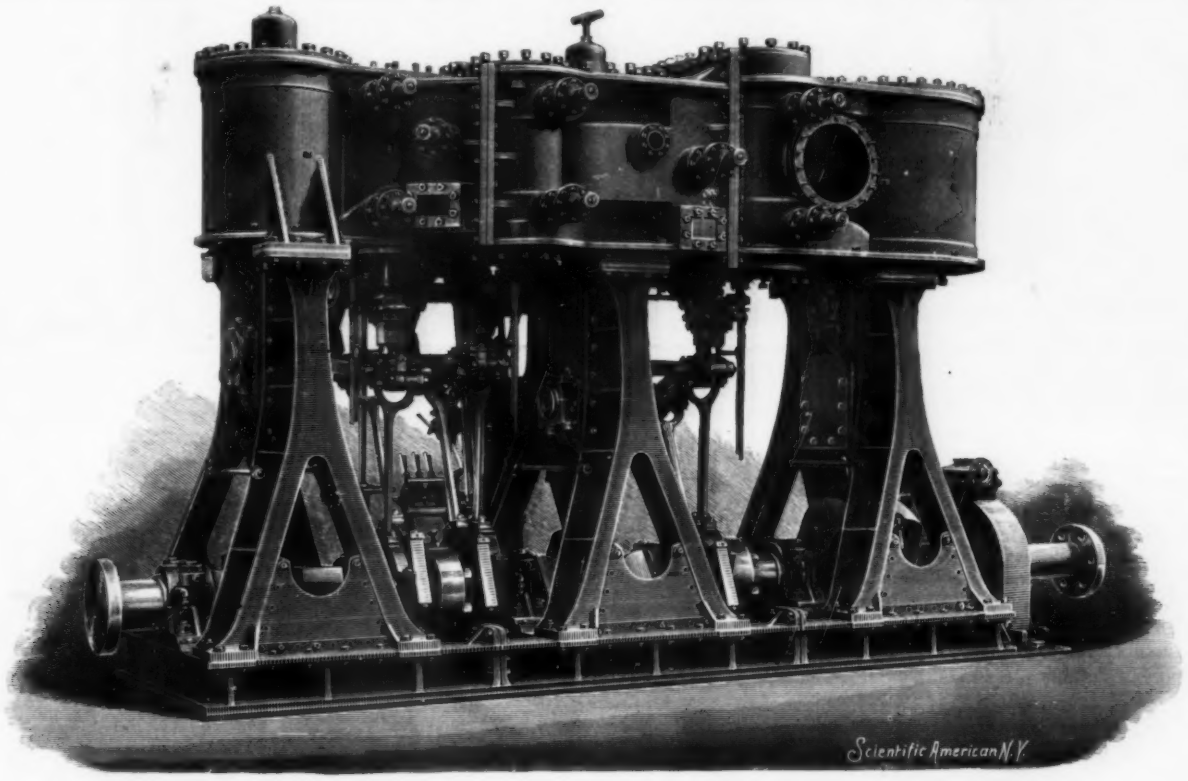
as given in the official records of the navy, are as follows:

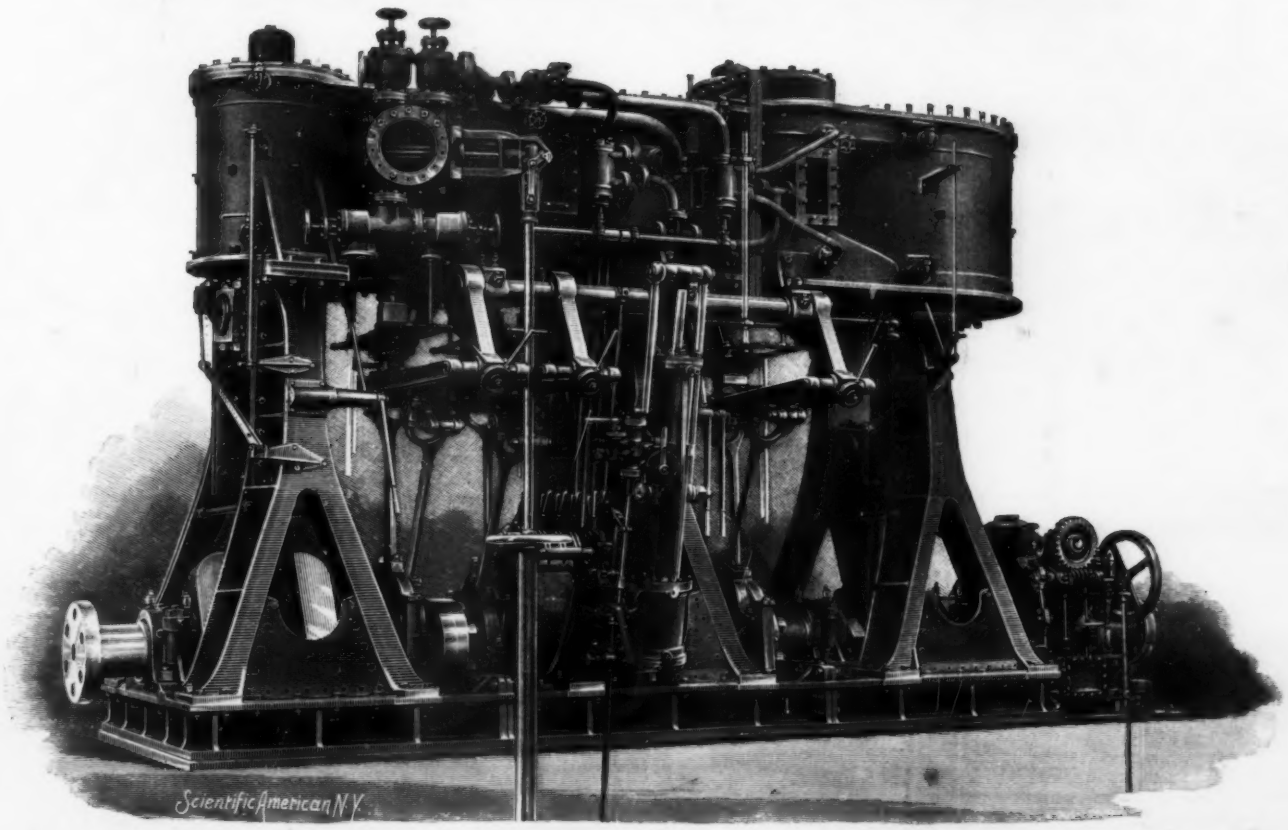
Length, 259½ feet; beam, 55½ feet; mean draught, 14 feet 6 inches; displacement, 3,999 tons; indicated horse power, 1,426. The maximum depth is 17 feet 4½ inches, leaving about 3 feet of freeboard. The engines are of the inclined compound type, and actuate twin screws. The armor of the hull consists of a protective belt 6 feet deep. The deck, which is almost flat, and non-deflective, is composed of two superimposed plates of ⅜-inch steel planked over with 4-inch pine.

The outer plating of the turrets is 11½ inches thick. This is backed with 10 inches of wood, which is again backed with two steel plates, each ½ inch thick. The turrets are 24 feet in external diameter, rise a little over 6 feet above the deck, and are each surmounted by a conning tower a little less than 8 feet diameter at the base, and projecting 2 feet above the top of the main turrets. In action, when the turret is struck, rivet heads or splinters are liable to be detached and to fly off with considerable velocity. To protect the firing crew from injury, an inner shield lines the turret. This shield is spaced off 8 inches from the backing, and is composed itself of ¾-inch steel plate. The deflective armor of the conning tower is 9 inches thick.

In each turret two 10-inch breech-loading rifles are mounted in parallel, and are manipulated by hydraulic gear. Each gun is held in place by hoops upon a saddle, which is free to slide back and forth upon the rails of the carriage. As shown in the cut, the carriage is pivoted to the turret at its front end, so as to be incapable of recoil. The recoil backward of the gun itself is checked by a hydraulic cylinder containing water, through which a piston is driven by the action of the gun on its recoil. A very limited waterway is provided for the escape of the water from behind the piston, so as to bring the gun to a stop without serious shock. With a full charge, the gun recoils about 40 inches.

Below the gun deck of the turret the space is utilized for the supply of ammunition. The shells and powder cartridges are brought in, and by means of a circular railroad are wheeled around the turret so as to come under the hatch, which, of course, shifts around as the turret turns. An elevator is provided for carrying them up to the gun deck, and there they are shipped on a carriage upon another transverse railroad, which brings them opposite the open breech of the piece. For loading, the breech is dropped, bringing the bore in line with an inclined hydraulic cylinder and rammer in its rear. An approximately vertical hydraulic cylinder and piston permit the breech to drop, or raise it, as desired. The shell is pushed home by a hydraulic rammer; next the powder is inserted, bag by bag, and pushed home by the same rammer. Brown perforated hexagonal prismatic powder (Dupont's) is used. It is packed tightly in the cartridge bags, several of which are used for a charge. In the rear of each bag are nine hexagonal grains of priming powder to disseminate the ignition. The breech block, which is of the interrupted screw type, with mushroom and gas check, is inserted and turned home, a copper priming needle is pushed through the axial vent of the breech block, so as to pick a hole in the rear powder cartridge; the primer, which may be frictional, detonating or electric, is put in place, and the gun is ready for firing. The direction of fire is fixed by rotating the turret. In the conning tower, the firing officer looks out of a little cross-shaped window, which in itself forms the rear sight; forward on the roof of the turret is the front sight. These two are arranged accurately parallel with the vertical planes passing through the axes of the guns. The elevation of the guns is determined by the hydraulic ram just mentioned, and actuated by a lever in the conning tower, and the firing officer has at his side a





TRIPLE EXPANSION ENGINES OF THE NEW UNITED STATES ARMORED COAST DEFENSE VESSEL "MONTEREY."

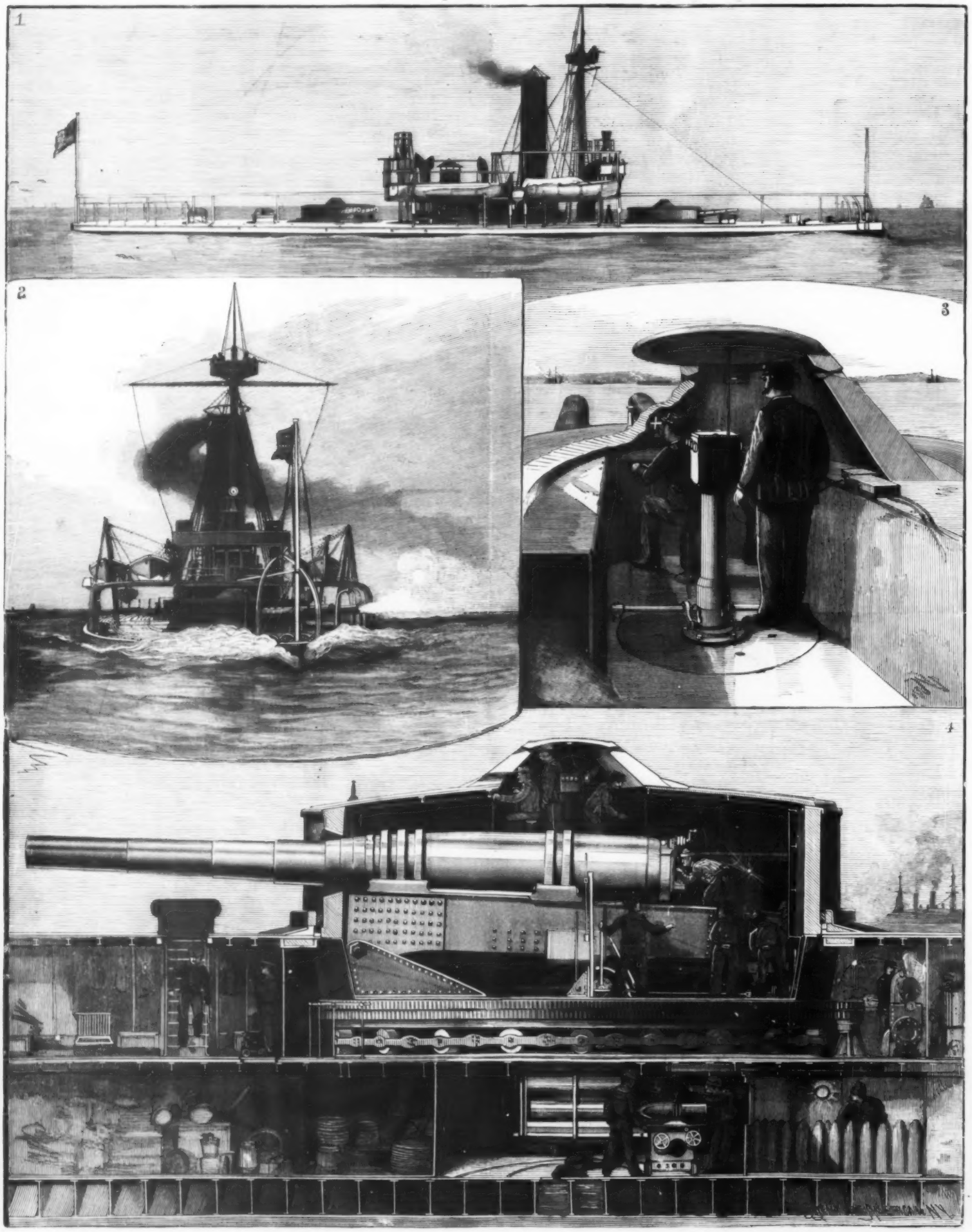
dial indicating the number of degrees of elevation given each piece.

Through the center of the turret a hollow spindle runs down to the bottom of the ship, through which communication is had from the conning tower to the different mechanisms required to be worked therefrom. Without leaving his place, the firing officer can locate the turret to bring his sight to bear upon the object, can raise or depress either or both of the guns to get the range, and can fire them singly or simultaneously, if desired, by the electric primers, simply pressing a button to produce the ignition. Immediately after firing, the turret can be rotated so as to present its unperforated side to the enemy, while the guns are being loaded. Levers and valve handles are provided for all the manipulation, within easy reach in the conning tower. By the speaking tubes and bell calls of the central spindle, the officers in the tower can communicate with all parts of the ship, including the other turret.

To prevent water from entering around the turret a diaphragm of leather is provided which encircles the base of the turret and is held down by segmental plates of metal and expansion turnbuckles against a wooden scupper groove. In action the turnbuckles are to be backed up a little to relieve the friction, so that the turret can be turned freely and without injury to the diaphragm.

A double line of teeth encircles the base of the turret, with which the turning engine engages. The turret is carried by 20 forged steel coned rollers, 14 inches diameter and 10 inches thick. Eight small horizontal rollers bear against the interior of the base, to prevent lateral displacement.

The vessel has a double bottom, a clear space of 28 inches existing between the two skins. She is lighted throughout by electricity.



1. Side view of the "Miantonomoh." 2. The "Miantonomoh" under headway. 3. Interior of conning tower. 4. Cross section of turret and hull.

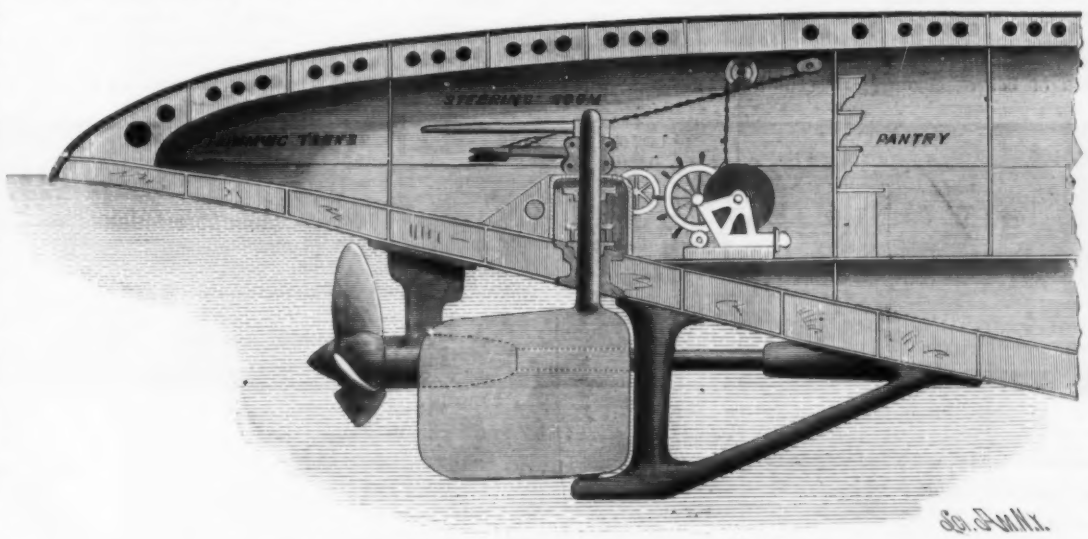
MONITOR "MIANTONOMOH."

ARMORED RAM "KATAHDIN."

By far the most unique ship in our navy, and, indeed, the only craft of its kind in the world, is the armored ram "Katahdin." The ram as a weapon of naval warfare is one of the most ancient of which we have any recorded history. It was used with deadly effect in the naval fights of Greece and Rome, and in later times, as at Lissa and during our own civil war, it proved a terrible engine of destruction.

The value of the ram as attached to the huge and swiftly moving warships of modern navies has yet to be determined, and many authorities claim that the ship which uses the ram is liable to be only less badly strained and shaken up by the shock than her opponent.

The "Katahdin," however, was designed for the express purpose of ramming, and her hull has been constructed with a view to her being able to withstand the terrible wrench which a ship that runs its nose at full speed into a moving vessel is certain to suffer. The dimensions of the vessel are as follows: Length over all, 251 feet; length on the normal water line, 250 feet 9 inches; extreme breadth, 43 feet 5 inches; breadth on water line, 41 feet 6 inches. The total depth from the base to the crown of deck amidships is 22 feet 10 inches and the normal draught of water is 15 feet, the corresponding displacement being 2,155 tons. The lower portion of the hull is dish shaped up to a sharp knuckle, which runs all around the vessel 6 inches below the normal water line, the angle of the knuckle amidship being about 90 degrees. Above this knuckle the shape of the hull is a circular arc, with a radius amidship of 39 feet, rising from 6 inches below to 6 feet above the normal water line. This curved deck is armor-plated throughout, the thickness of the armor tapering from 6 inches at the knuckle to 2 inches at the crown of the deck. Above this deck is a conning tower, a smokepipe and ventilators and two light barbettes, within which the 6-pounder guns are mounted, and skid-beams for carrying the boats. Longitudinally from the point of the ram to the stern the lower portion of the hull is shaped in a fair curve, but the upper portion is straight from the head of the stem to within about 30 feet from the stern, from which point it rounds down to the knuckle. An armor belt, from 6 inches to 3 inches thick and 5 feet deep, extends below the knuckle.



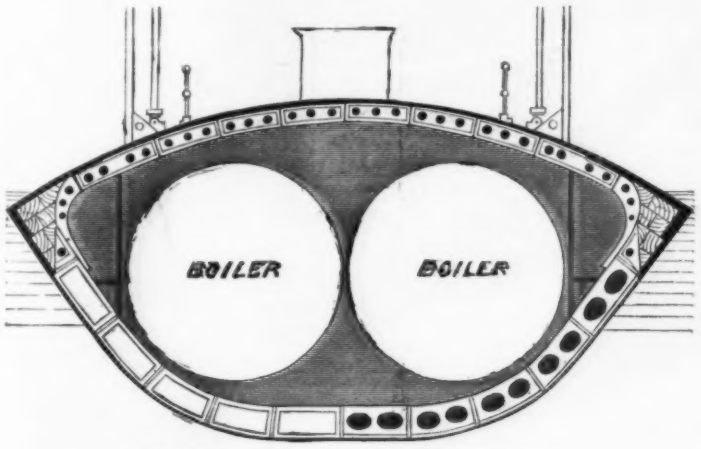
RAM "KATAHDIN"—PROPELLER AND STEERING APPARATUS.

The hull is framed by continuous longitudinal girders, both below and about the knuckle, which, gathering together at the bow and stern, make a rigid structure. A continuous watertight inner bottom, 2 feet from the outer skin, is carried the whole length of the vessel and up to the armor shelf on each side. The double bottom is divided and subdivided by the longitudinal and transverse frames into 72 watertight compartments. The inner hull is further subdivided by watertight bulkheads, both longitudinal and transverse.

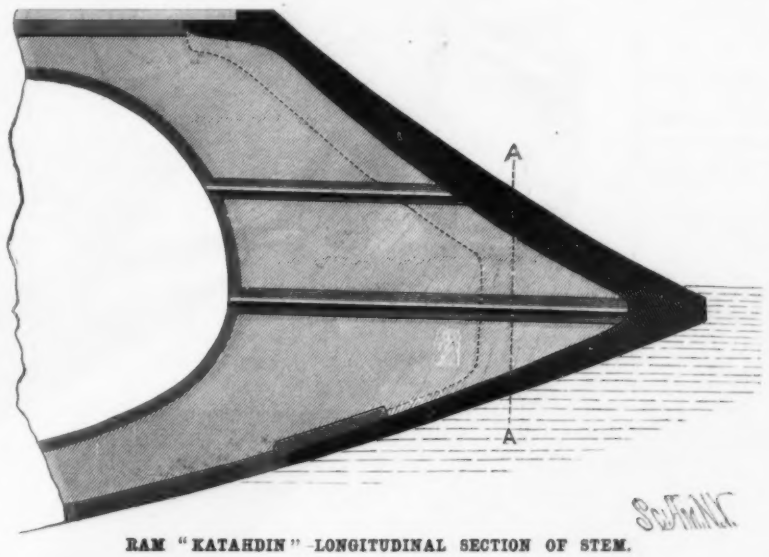
The ramhead is of cast steel (see cut), extending back 11 feet in a vertical line, and is supported by the longitudinal braces in such a way that the force of the blow delivered by it is designed to be distributed through the vessel. The maximum speed, at full power, is 16·1 knots, and the impact of the ram is equivalent to the blow of a hammer weighing over 2,000 tons moving at this rate of speed—a blow which, if fairly delivered, would crash through the sides of any vessel afloat.

The motive power consists of two sets of vertical triple-expansion engines, and there are two double-ended and one single-ended cylindrical horizontal five-tube boilers placed in watertight compartments. The maximum horse power on trial was 5,068. There is a complete installation of electric lights, sufficient for lighting all parts of the vessel. It is arranged that the vessel may be submerged to her fighting trim by means of fourteen 8-inch Kingston outboard valves, one in each transverse watertight compartment of the double bottom. When not submerged the vessel is designed to have sufficient freeboard for coasting service.

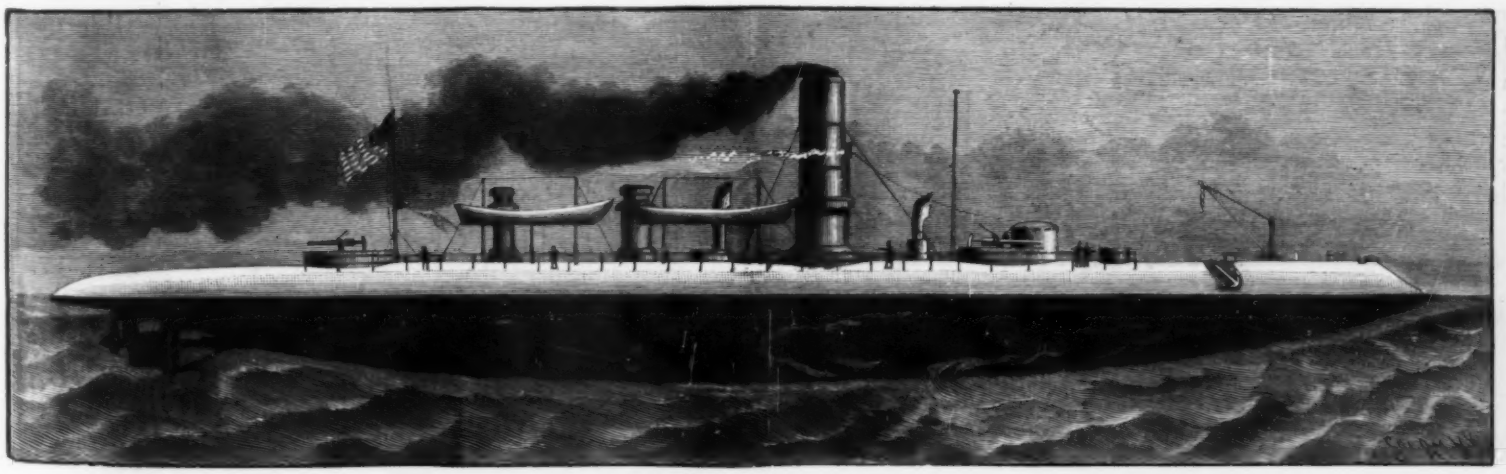
The accommodations for both officers and men are roomy and as comfortable as can be made on a vessel of her peculiar build. The quarters for the officers are on the after berth-deck, just abaft the engine room bulkhead, and the wardroom has seven staterooms and a pantry. The forward berth-deck is designed entirely for the crew, but there is an apartment abaft the officers' quarters which may be used as additional berthing space. The vessel was built at the Bath Iron Works, Maine, and she takes her name from Mount Katahdin, the loftiest point in that State.



RAM "KATAHDIN"—CROSS SECTION AMIDSHIPS.



RAM "KATAHDIN"—LONGITUDINAL SECTION OF STEM.



ARMORED RAM "KATAHDIN."

Displacement, 2,155 tons. **Speed**, 16·11 knots. **Maximum Coal Supply**, 193 tons. **Complement**, 97. **Armor**: Sides, 3 to 6 in.; deck, 2 to 6 in. **Guns**: Four 6-pounder rapid-firers. **Authorized** 1889.

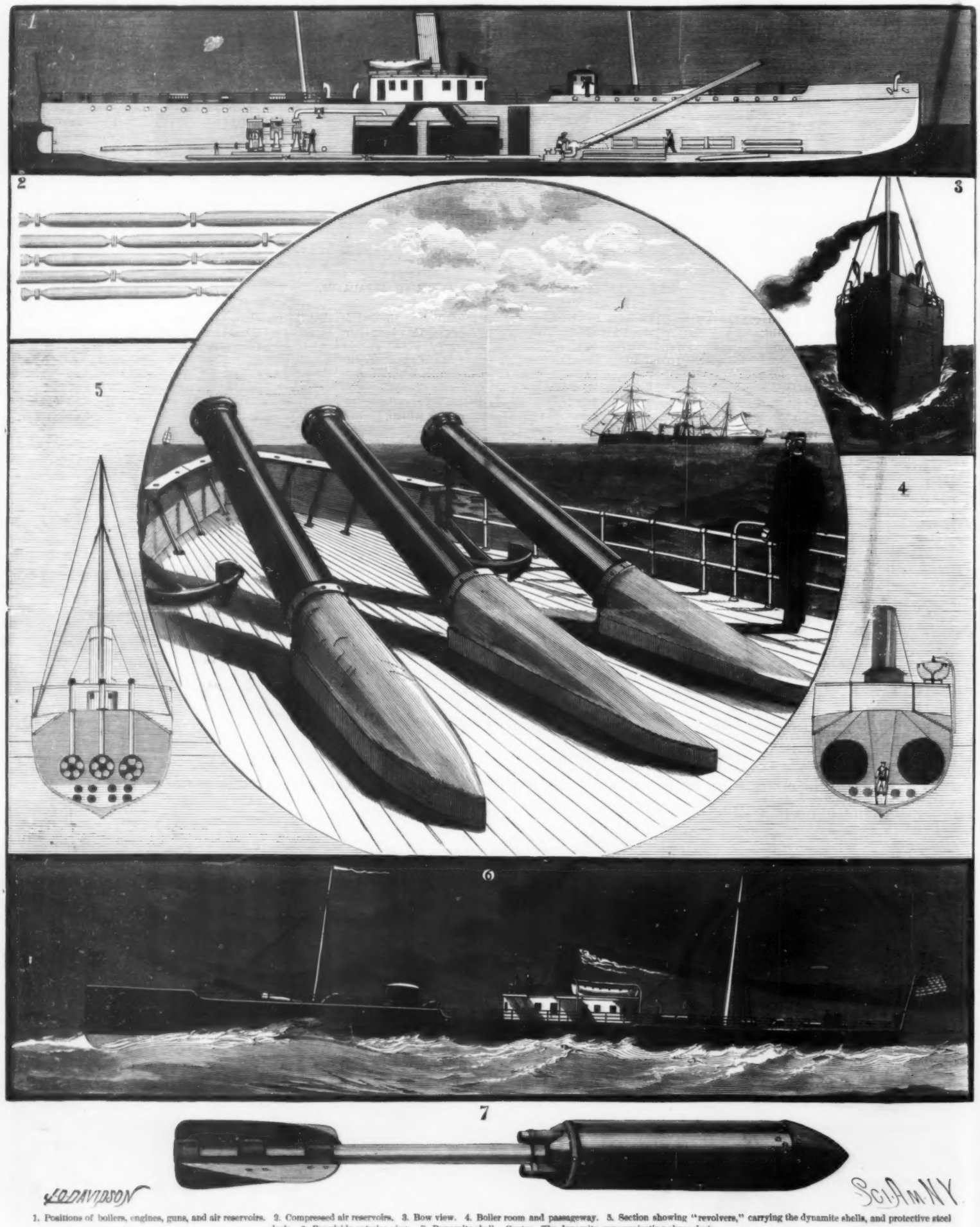
DYNAMITE GUNBOAT "VESUVIUS."

THE "Vesuvius," like the "Katahdin," is a type of vessel that is only to be found in the United States navy. She was designed for carrying dynamite guns of considerable range and enormous power, and it is upon these that she depends for her offensive power. She was authorized in 1886 and built by the Cramps, of Philadelphia, the date of her first commission being June 7, 1890. The general details of her interior arrangements, disposition of boilers, engines, armament, etc., are shown in the accompanying illustrations.

The illustration, Fig. 6, shows the "Vesuvius" as she appeared on her trial trip. Minor changes have since been made, such as the additions of a flying bridge and several ventilators and boats, which do not materially alter her appearance.

In the forward part of the ship are placed the three pneumatic guns that form her armament. These are built into the ship. Their muzzles are carried forward and project above the deck near the bow at an elevation of 18 degrees. They are 15 inches in diameter, 54 feet long, and are made of thin cast iron. They are not rifled, the vanes upon the projectile being relied on to give any desired axial rotation.

The full-sized shell for this gun is 14¾ inches in diameter, and its body is about 7 feet long. Back of the body is a tail fitted with spiral vanes, which secures its alignment and rotation. This is the largest shell the gun can fire, and the effects of its heavy charge of ex-



1. Positions of boilers, engines, guns, and air reservoirs. 2. Compressed air reservoirs. 3. Bow view. 4. Boiler room and passageway. 5. Section showing "revolvers," carrying the dynamite shells, and protective steel deck. 6. Broadside exterior view. 7. Dynamite shell. Center—The dynamite guns projecting above deck.

DYNAMITE GUNBOAT "VESUVIUS."

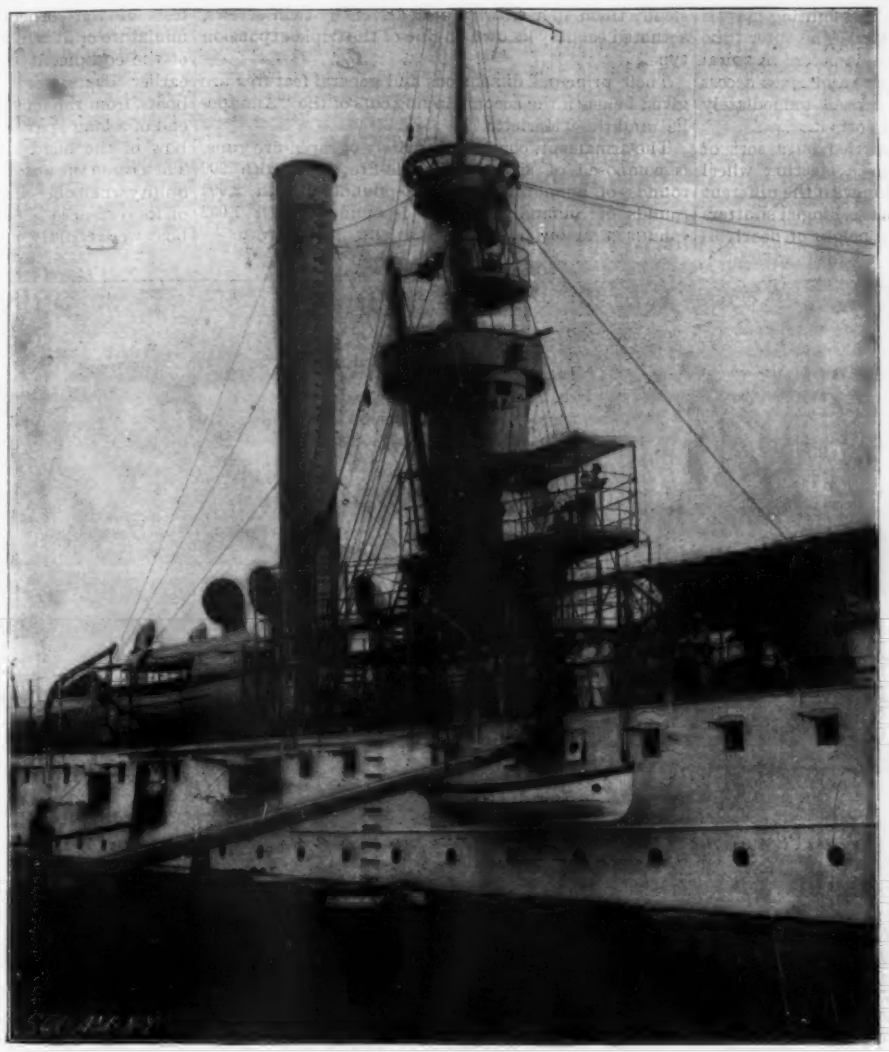
Displacement, 929 tons. **Speed**, 21·42 knots. **Maximum Coal Supply**, 152 tons. **Complement**, 69. **Armament**, three 15-in. dynamite guns, three 3-pounder rapid-fire guns. **Authorized** 1886.

plosive can only be surmised. In trials by the government of the dynamite gun an old government coast-survey schooner was completely wrecked at a one mile range by 50-pound charges fired from an 8-inch gun. According to the opinion of students of torpedo practice, the submarine explosion of a shell from the "Vesuvius" would destroy a ship 20 or more feet distant.

The air for discharging the projectiles is compressed by two Norwalk compressors into reservoirs consisting of a number of tubes. These are made of wrought iron, 16 inches in diameter and thirteen-sixteenths inch thick. The firing reservoirs contain 210 cubic feet of compressed air, the storage reservoirs contain 420. The air is stored at 2,000 pounds pressure per square inch, and the firing reservoir is maintained at a pressure of 1,000 pounds. Each shot at one mile range reduces its pressure 150 pounds. This deficit is immediately supplied from the storage reservoir.

Under the rear of each gun are placed two "revolvers" in line with each other. Each contains five chambers, for holding as many torpedoes. To load a gun, its breech is dropped, swinging downward on a pivot at its extreme rearward end. The opening points forward and comes directly opposite and in line with the lowest chamber of the after revolver. By a hydraulic ram the shell is pushed into the breech, which is at once swung upward, again completing the continuity of the barrel. The revolver is then turned one division, so as to be ready for supplying a second shell. When the after revolver is empty, it is filled from the forward one in the same way. All these maneuvers are executed by hydraulic power. Ten projectiles are provided for each gun, giving a total of thirty. This is the full armament of the ship as far as torpedoes are concerned.

The ship is steered by steam. All of her operations will be directed or executed from a conning tower placed on her deck. In firing, the guns have a fixed elevation. Their range is varied by admitting more or less air. This is effected by the firing valve, which is constructed so that any desired amount may be used with certainty. The pointing of the guns is executed by the movements of the vessel. The officer in the conning tower has under his control the ship with her guns, and he trains her upon the enemy, in the same sense that an artillery officer moves his gun carriage, so as to point in the desired direction the piece it carries. The hull of the "Vesuvius" is actually a floating gun-carriage carrying three pneumatic guns.



GUNBOAT "HELENA."

Displacement, 1,392 tons. **Speed**, 15·50 knots. **Maximum Coal Supply**, 300 tons. **Complement**, 175. **Armor:** $\frac{5}{16}$ in. to $\frac{3}{8}$ in. watertight deck. **Guns:** Main battery, eight 4-in. rapid-fire; secondary rapid-fire battery, four 6-pounders, four 1-pounders, two Colts, one field gun. **Authorized** 1893.

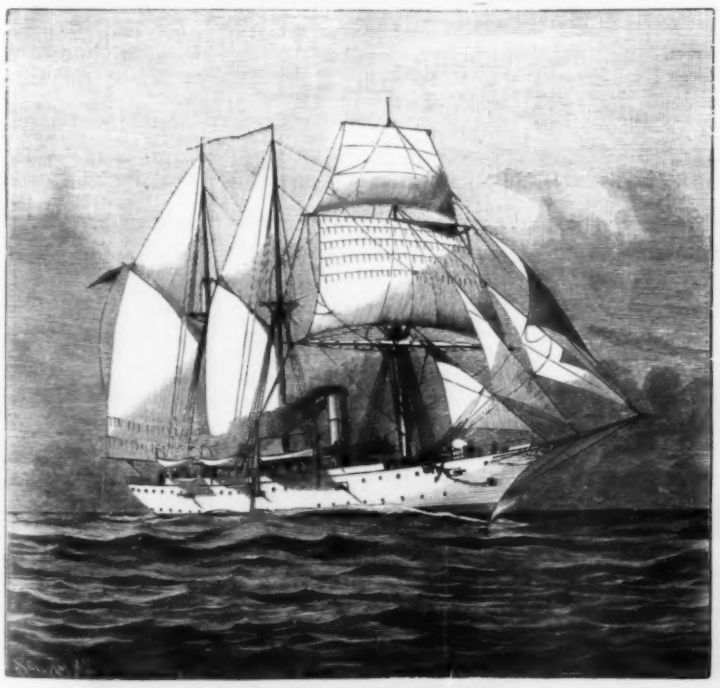
GUNBOATS.

GUNBOAT "HELENA."

THE "Helena" is one of three light-draught gunboats authorized in 1893, and constructed by the Newport News Shipbuilding Company. Two of these, the "Helena" and the "Wilmington," are sister ships. Their dimensions are: Length, 250 feet 9 inches; beam, 40 feet; draught, 9 feet; and displacement, 1,392 tons. The "Helena" has a trial speed of 15½ knots and her complement is 175 all told. The ship was specially designed for service on the rivers of China, and was originally intended for the Asiatic station, whither she was proceeding by the Mediterranean route when she was directed to remain at Lisbon until further orders. There were at that port also the "San Francisco" and the "Bancroft," the three vessels composing our European squadron, when, on March 12, the Secretary of the Navy ordered the "Helena" and the cruiser "Bancroft" to Key West.

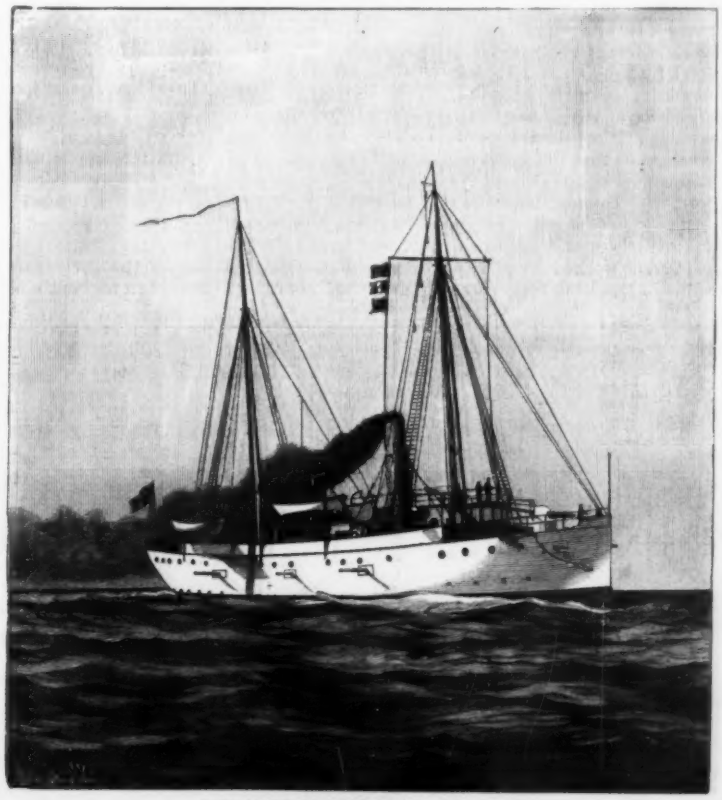
As we have said, this little vessel was designed for service on the Chinese rivers, and this accounts for her abnormal dimensions; for it will be seen that with a beam of 40 feet she draws only 9 feet of water. She is driven by twin-screw engines of 1,988 indicated horse power, and her twin screws, coupled with her large rudder area, give her excellent turning power—a valuable feature in river work.

While the boat was being planned a Japanese officer happened to see the designs, and he suggested the utility of a conning tower of sufficient elevation to overlook the banks of the Yellow River of China, the Yang-tse-Kiang. These banks are so high that they exclude the view of the country from those on an ordinary ship's deck. The Navy Department acted on the hint, and the result was the curious combined conning tower and



COMPOSITE GUNBOAT "ANNAPOLIS."

Displacement, 1,000 tons. **Speed**, 13·17 knots. **Maximum Coal Supply**, 225 tons. **Complement**, 135. **Armament:** Main battery, six 4-in. rapid-fire guns; secondary battery, four 6-pounders, two 1-pounders, one Colt, one field gun. **Authorized** 1895.



COMPOSITE GUNBOAT "MARIETTA."

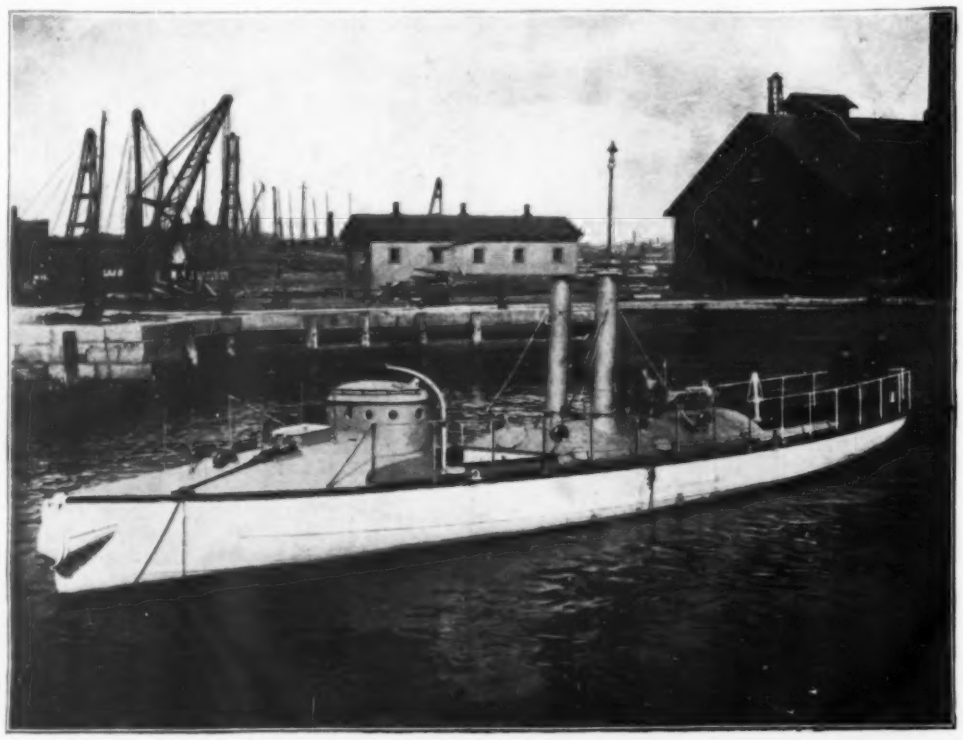
Displacement, 1,000 tons. **Speed**, 13·03 knots. **Maximum Coal Supply**, 236 tons. **Complement**, 140. **Armament:** Main battery, six 4-in. rapid-fire guns; secondary battery, four 6-pounders, two 1-pounders, one Colt, one field gun. **Authorized** 1895.

fighting mast shown in our cut. The fighting mast is composed of an outer and inner tube. The outer tube is 6 feet, the inner tube is 2 feet in diameter. A spiral staircase winds around the inner tube and gives access to the conning tower, which is carried immediately below the lower top and partly supports it.

The conning tower itself is carried on a sort of sponson on the mast. It contains a steering wheel and all appliances for communication with the different parts of the ship. The windows have hinged shutters with small openings. In it, from a height of nearly 50 feet, the commanding officer can overlook the obstacle presented by the high banks of the river, and can observe the enemy's actions to great advantage, should an inclination be shown to attack the ship.

Immediately above the conning tower is the lower fighting top, in plan a circle of 14 feet diameter. Access to this top is had by foot rounds attached to the outside of the 2-foot mast tube. The spiral stairs stop when they reach the floor of the conning tower. The 2-foot tube, still rising, carries the electric light top, and above this a fighting top, a 6-foot circle, with a 10-foot ring bracketed above the top and concentric with it. From the center of the upper top the signal pole rises nearly 28 feet further.

The "Helena" carries an armament of eight 4-inch rapid-fire guns as her main battery and in the secondary battery are four 6-pounders, four 1-pounders, two Colts and one field gun. The new navy contains ten unarmored gunboats of the general type of the "Helena," whose displacement varies from 892 to 1,777 tons.



TORPEDO BOAT OF THE "MAINE."

Displacement, 15 tons. **Speed**, 18 knots. **Length**, 61 ft. 8 in. **Beam**, 9 ft. 1½ in. **Draught**, 3 ft. 4 in. **Complement**, 5. **Armament**; One 18-in. Whitehead torpedo tube, one 1-pounder rapid-fire gun. **Authorized** 1886.

LIGHT DRAUGHT COMPOSITE GUNBOATS "ANNAPOLIS" AND "MARIETTA."

The rapid accumulation of barnacles and marine vegetation on the bottoms of steel-plated warships; the incidental reduction of speed, with an accompanying increased consumption of coal; and, finally, the semi-annual docking necessitated, with its consequent expense, have troubled the navy department ever since the first ships of the new navy were launched. The composite system of construction was introduced to avoid these evils. The composite vessel is built with steel frames and is plated with steel above and with planking below the water line, the planking being coppered as in the wooden sailing ship. Where greater strength is required it is built with a complete steel shell, and the under-water plating is wood-sheathed and coppered, the sheathing being fastened to the steel frames by composition bolts.

Six vessels of this class have been built, one type having full sail power and propelled, when steaming, by a single screw worked by a triple expansion engine, the ships of the other type carrying merely sail enough to steady them in a seaway, and driven by twin screws, actuated each by its own engine of the triple expansion type.

Their principal dimensions and general features are given beneath the accompanying cuts of the "Annapolis" and the "Marietta."

The armament, consisting entirely of rapid-fire guns, is composed of six 4-inch rapid-fire guns, with 900 rounds of ammunition; four 6-pounders, with 2,002 rounds of ammunition; two 1-pounders, with 1,002 rounds of ammunition; one Colt and one field gun.

Two of the 4-inch rifles, one at the bow and one at the stern, are carried on the main deck; the other guns, excepting the 1-pounders on the hammock berthing, are placed to good advantage on the gun deck and well protected from musketry fire, to which the river and shallow water service may expose them.

When a sheathed and coppered vessel is in motion the weight of any marine growth, assisted by the characteristic exfoliation of the copper plating, would cause its release, and in this very simple natural evolution we have a means of making these vessels more extensively independent of coaling stations and docking facilities than the ordinary steel plated ships, while assuring them a much more extended radius of action.

TORPEDO BOATS.

ONE of the earliest successful attempts to make use of the torpedo boat in naval warfare occurred in the Civil War, when the "Housatonic" was sunk by a rebel craft, which paid for its daring with its own destruction, being sucked into the ghastly hole which it had torn in the man-of-war. This was one of the lessons of the Civil War which was laid to heart by the European nations, and out of this and later successful tests of the torpedo has sprung that vast fleet of miniature craft which forms such a formidable feature of the equipment of the navies of the world. The earlier boats were what is known as spar torpedo boats, from the fact that the torpedo was carried at the end of a long spar which projected forward from the bow of the boat, the torpedo exploding by contact. Then came the automobile Whitehead torpedo, with its ability when once discharged to run from 600 to 800 yards of its own accord. The size and speed of the torpedo boat were rapidly increased, especially the latter, and the importance of this method of attack was increasingly recognized. The torpedo boat of twenty-five years ago, with its spar torpedo, was a diminutive affair, having a speed of only 12 or 13 knots. In 1877, however, it had grown to have a length of from 85 to 100 feet and a speed of from 18 to 21 knots. As the demand increased, the builders paid particular attention to reduction of weight and increase of boiler and engine efficiency, and in 1887 the "Ariete," built by Thornycroft for the Spanish government astonished the world by running a mile at the speed of 26 knots an hour. Five years later the "Daring," a 220-ton boat built by Thornycroft for the British navy, made 28·65 knots an hour, and in 1895 the "Sokol," built by Yarrow for the Russian government, passed the 30-knot limit.

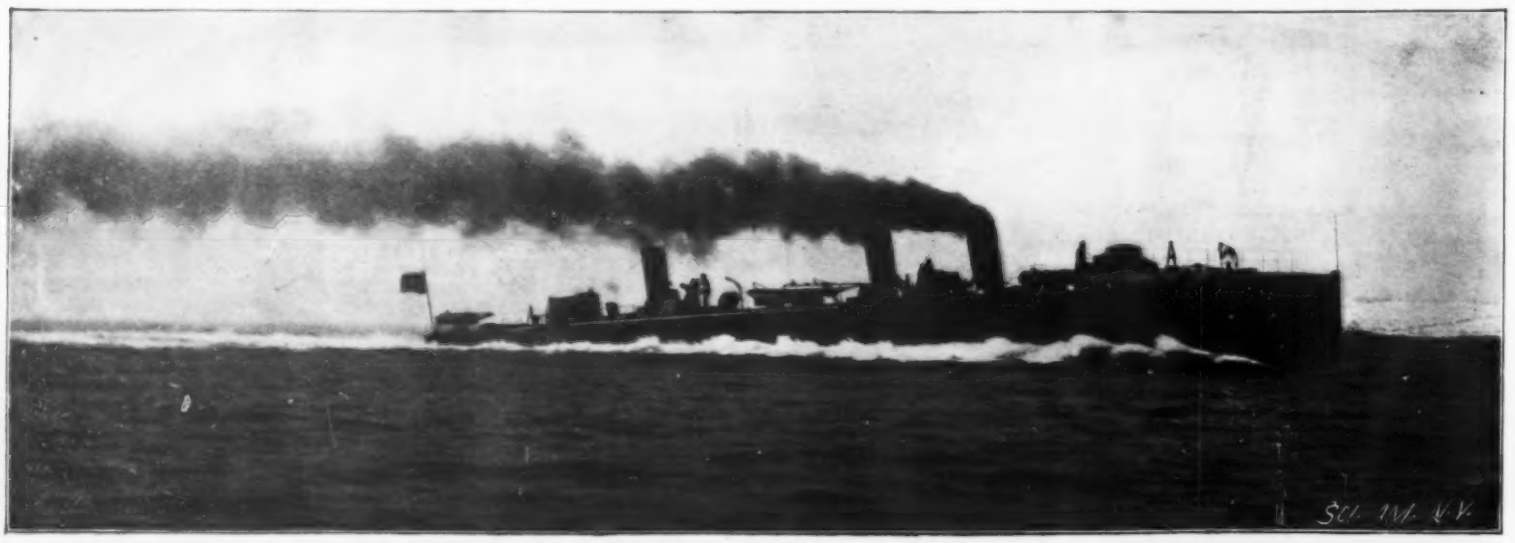
The later torpedo boats are known as destroyers. They are large vessels of 300 to 400 tons displacement and powerful enough to maintain their speed in rough weather, which the torpedo boat cannot do. They have a speed from 30 to 33 knots and carry a powerful armament of rapid-fire guns, the object being to enable them to chase and sink a fleet of torpedo boats and prevent them from attacking the larger ships. At the same time the destroyer carries a full complement of torpedoes and would be capable of sinking battleships and cruisers if she could get within torpedo range.

It is greatly to be regretted that in the earlier years of our naval construction we omitted to provide the navy with an adequate torpedo fleet, as we are likely to suffer somewhat from the lack of them in the event of hostilities. The defect is being remedied, however, as fast as the boats can be turned out, and the present Congress has recommended the construction of thirty craft of the kind in addition to those already on the stocks.

We have chosen three boats for illustration, the ship's torpedo boat of the kind carried by the ill-fated "Maine," the first-class torpedo boat "Porter" and the destroyer "Bailey."

PORTABLE TORPEDO BOAT CARRIED BY THE "MAINE."

This little craft, which was wrecked at the time of the "Maine" disaster, was 61 feet 8 inches long, 9 feet



FIRST-CLASS TORPEDO BOAT "PORTER" ON HER TRIAL TRIP.

Speed, 28·63 knots per hour. From an instantaneous photograph. Copyrighted, 1897, by F. H. Child.

1½ inches in beam, the extreme draught was 3 feet 4 inches, and displacement 12·45 tons. With coal and stores aboard she weighed about 15 tons, and she was provided with four heavy eyes by which she could be hoisted from the water to her cradle above the "Maine's" superstructure deck by a derrick and steam winch. The hull was built of extremely thin plating, her sides in places being only $\frac{3}{16}$ of an inch thick. Six bulkheads divided the interior into seven watertight compartments. The general arrangement of the boat was as follows: There was an open cockpit aft, into which the rudder head entered, so that the boat could be steered from this cockpit if the conning tower had to be deserted. Forward of the cockpit was the engine room, with a quadruple-expansion engine. Forward of the engine was the boiler room arranged for forced draught by the closed fire room system. The boilers were of the Mosher tubulous type. Next to the boiler room was another open cockpit, forward of which was the conning tower, which contained a steering wheel. In the bows was built the torpedo tube for discharging a Whitehead torpedo. In the extreme bow and also under the stern cockpit were trimming tanks. On deck aft was mounted a 1-pounder rapid-firing gun, whose ammunition was carried in a magazine just aft of the engine room.

Along each side of the boat were the coal bunkers, which, as far as their diminutive size permitted, might be considered protective. Small torpedo boats of this class are very serviceable for carrying dispatches and performing many of the duties which fall to the lot of a steam launch.

FIRST-CLASS TORPEDO BOAT "PORTER."

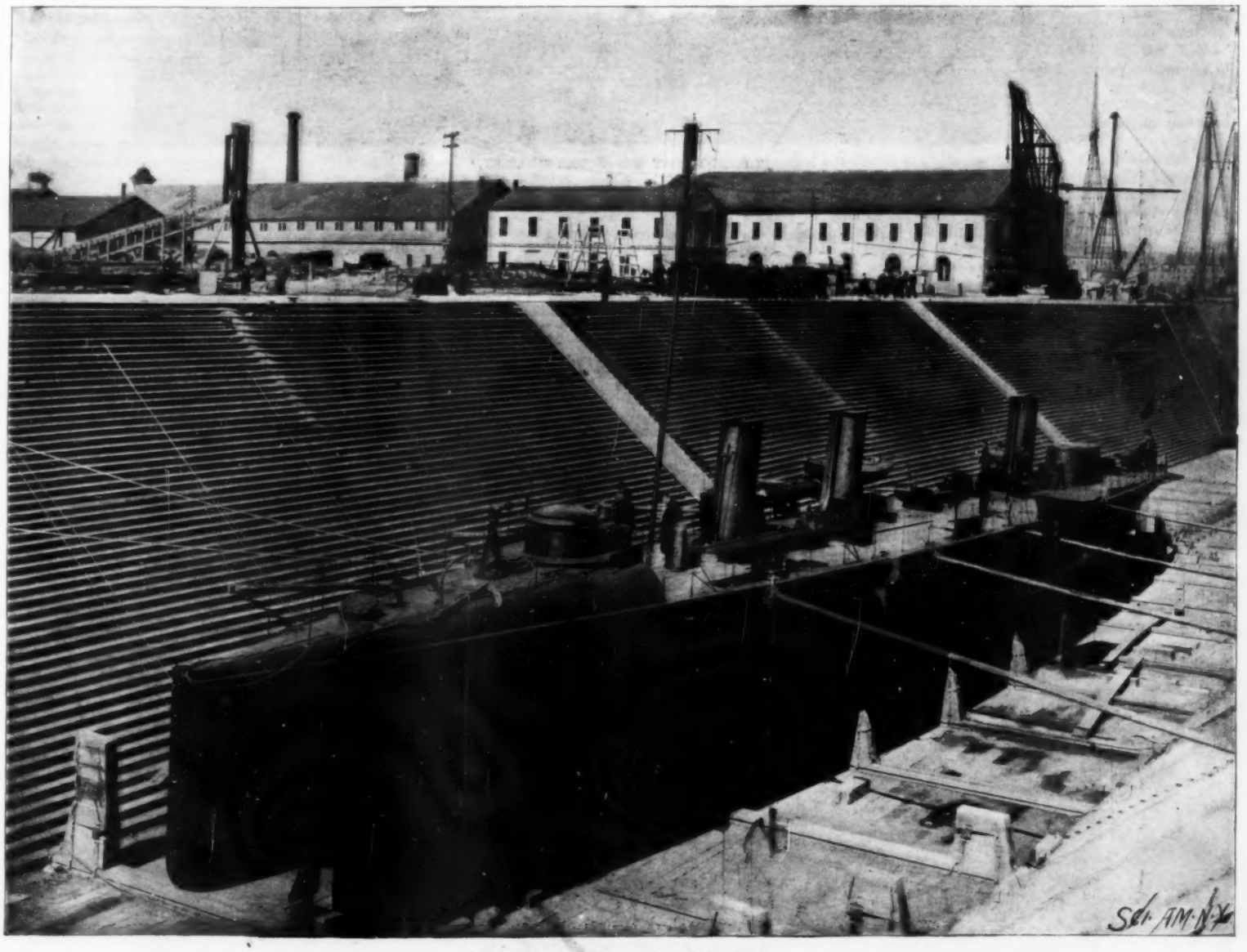
The "Porter" is one of three first-class torpedo boats authorized in 1895, and she was the first torpedo boat of this class commissioned in the United States navy. Her high speed and rapid-fire guns make her serviceable as a torpedo boat destroyer. Her principal dimensions are: Length, 175 feet; beam, 17 feet; draught, 5 feet 6 inches; and displacement, 190 tons. She is driven by twin-screw, quadruple-expansion engines of 4,000 horse power. She is of extremely light construction, none of her plates being over one-fourth of an inch in thickness and her framing being light in proportion.

We present two excellent illustrations of this vessel, one taken when she was running at a speed of 28·63 knots or 33 miles an hour, and the other showing her in dry dock at the Brooklyn Navy Yard. On the trial trip the pressure at the engines was 220 pounds and they ran at 405 revolutions per minute. There were two excellent features that made themselves apparent to those on board, the first being the absence of any banking up of a bow wave (the commotion which our readers will notice in the cut being merely the surface foam), and the second good feature was the absence of extreme vibration. The "Porter" and a sister boat were built by the Herreshoffs, of Bristol, R. I.

Referring to the larger cut, it will be noticed that the water line shows a draught of about 4 feet at the bow, but when the boat is being driven at its full speed of nearly 29 knots an hour, it settles at the stern and lifts its forefoot clear of the water to such an extent that 5 or 6 feet of the keel is visible. This is a common occurrence when light-draught torpedo boat destroyers and pleasure yachts are driven at speeds in the neighborhood of 30 knots an hour.

Owing to the altitude from which the photograph showing the "Porter" in dry dock was taken, we get an excellent idea of the arrangement of the deck. It will be noticed that a turtleback deck extends from the bow aft as far as the rear of the forward conning tower. This is intended to give the boat increased buoyancy when she is running against a head sea. Just forward of the conning tower is a 1-pounder rapid-fire gun on a tripod mount. Two other 1-pounder guns on similar mounts are located on either beam and another toward the stern. The long cylindrical object seen on the port side of the boat in front of the forward funnel is a torpedo launching-tube. There is another one amidships on the starboard side, and a third tube is located at the stern on the center line. The launching-tube is nothing more nor less than a gun, of which the torpedo is the projectile. The latter, loaded with its charge of explosive, and with its air reservoir charged with compressed air, is thrust into the gun, or tube, at the breech; the breech block is then closed and the torpedo is ejected by firing a small charge of powder or releasing a charge of compressed air. The launching-tube is carried upon a central pivot mount, and may be trained on the mark in the same way as an ordinary gun. In making an attack, the torpedo boat would charge upon the ship at full speed, and when she was within torpedo range she would swing round to port or starboard so as to bring her launching-tubes to bear. If the torpedoes fired from amidships failed to reach the mark, she would have another chance with the tube that is located at her stern.

As the "Porter" is built of the very thinnest kind of plating, she would be penetrable by the smallest rapid-fire guns of the enemy, and the mad charge through the hail of bullets and shells that would be rained upon her would evidently be somewhat of the nature of a forlorn hope. However, it is not likely that torpedo boat attack will often be carried out in broad daylight. The best work of these little boats will be done on dark nights and in foggy weather; and even if they never strike a blow, the moral effect which they will exercise will be well worth the cost of their construction and maintenance.



FIRST CLASS TORPEDO BOAT "PORTER."

Displacement, 190 tons. **Speed**, 28·63 knots. **Maximum Coal Supply**, 76 tons. **Length**, 175 ft. **Beam**, 17 ft. **Draught**, 5 ft. 6 in. **Complement**, 32. **Armament**: Three 18 in. Whitehead torpedo tubes, four 1-pounder rapid-fire guns. **Authorized** 1895.

TORPEDO BOAT DESTROYER "BAILEY."

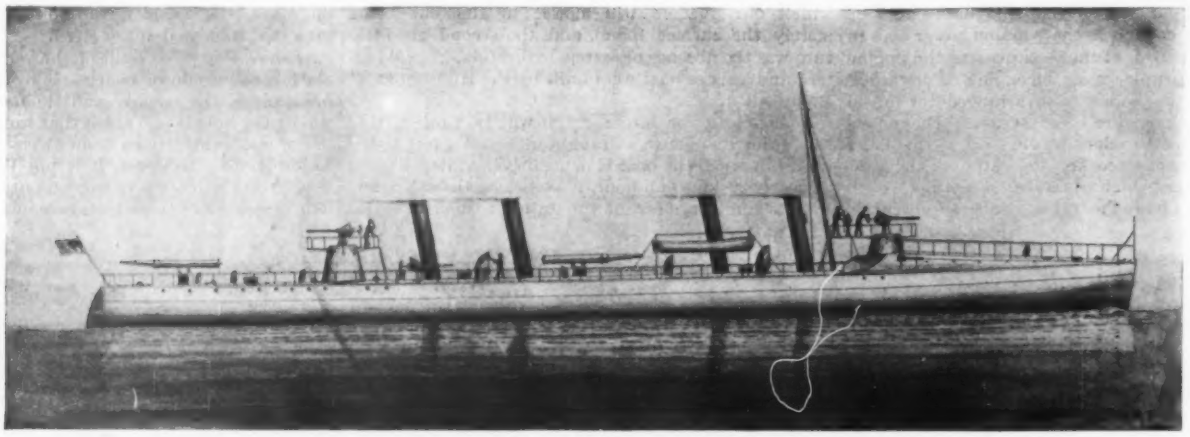
The accompanying engravings represent the new torpedo boat destroyer "Bailey," so named by order of the navy department after the distinguished naval officer Theodorus Bailey, who was second in command to Farragut in the action of passing Forts Philip and Jackson, on the Mississippi. The "Bailey" is one of three torpedo boat catchers for which provision was made at the last session of Congress. The sum appropriated for each boat was $250,000. In advertising for bids the navy department stipulated that a speed of 30 knots per hour would be exacted on the official course. The details of the design were left to the discretion of the builders. The contract for the "Bailey" was awarded to Charles L. Seabury & Company and the Gas Engine and Power Company, of Morris Heights, New York, and she is now nearing completion at their yards on the Harlem River.

If we except the "Porter," which is, strictly speaking, a first-class torpedo boat, the "Bailey" and her mates are the first destroyers to be built for our navy; and if the expectations of her builders are fulfilled, she will be capable of a speed of 33 knots an hour. The principal features of the designs are: Length, 205 feet; beam, 19 feet, ; depth of hold, 13 feet 5 inches; displacement on trial, 235 tons; and displacement when in commission, 265 tons.

The armament will be a powerful one for a boat of this size. It will embrace four 6-pounder rapid-fire guns and two 18-inch torpedo discharge tubes. The latter are for Whitehead torpedoes.

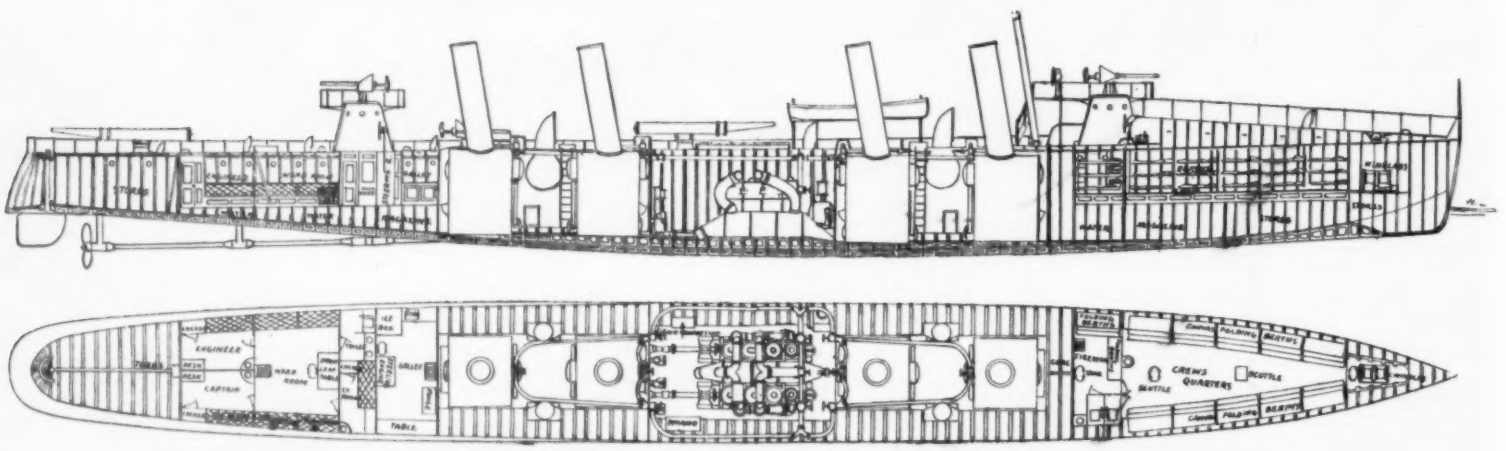
The 6-pounder guns will be mounted two on the main deck, one on each side amidships, and two on platforms supported by the conning towers. The deck guns will have an arc of fire from sharp on the bow to right astern. The guns on top of the conning towers will have an almost all-around fire.

As in the case of all high-speed vessels, there is no feature more interesting than the motive power. The "Bailey" will be supplied with engines capable of developing 5,600 horse power. This power is more than one-half the power employed on the Cunard steamer "Umbria." The latter is a vessel of some 8,000 tons displacement, while the "Bailey" on trial will displace but 235 tons. The "Bailey's" engines are of the four-cylinder triple-expansion type. The diameters in inches for the high, intermediate and low pressure cylinders respectively are 20, 30½ and 32. The con-



TORPEDO BOAT DESTROYER "BAILEY."

Displacement, 235 tons. **Speed**, 30 knots. **Horse Power**, 5,600. **Radius of action**, 3,000 knots. **Length**, 205 ft. **Beam**, 19 ft. **Draught**, 6 ft. **Complement**, 40. **Armament**: Two 18-in. Whitehead discharge tubes, four 6-pounder rapid-fire guns. **Authorized** 1897.



LONGITUDINAL SECTION AND PLAN OF THE BAILEY."

SUBMARINE TORPEDO BOAT "HOLLAND."

Displacement, 75 tons. **Length**, 55 ft. **Diameter**, 10½ ft. **Armament**: One Whitehead discharge tube, one aerial dynamite gun, one under-water dynamite gun.

mon stroke is 18 inches. The development of 5,600 horse power is expected when the engines are making about 400 revolutions per minute.

Steam will be furnished by four Seabury water tube boilers. Each boiler will be equipped with two furnaces. The working pressure will be 250 pounds to the square inch. As arranged, there will be two fire rooms. Each boiler will have its own funnel, making four in all.

In the crew space forward there will be folding berths for thirty-three men. Of this number, eight will be for the machinists. The officers' bunks will be Pullman car berths, fitted into the sides of the boat, aft in the wardroom.

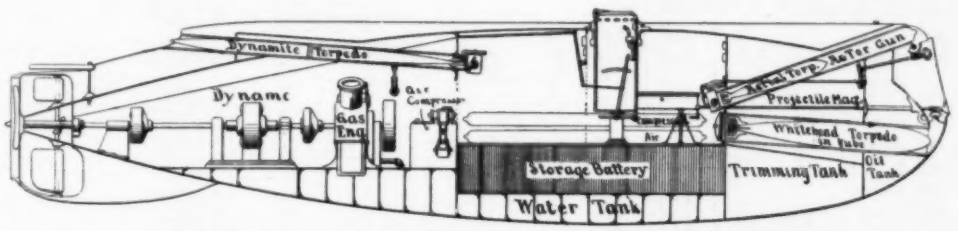
The "Bailey," like the "Dupont" and "Porter," will be able to do battle with battleships after the fashion of torpedo boats. When thus engaged she will have recourse to her torpedo tubes. But we have shown the principal duty of the new craft will be to drive off and annihilate with gun fire the torpedo boat torments of the battleships and cruisers. Speed alone will enable the "Bailey" to do this, and this speed the catcher is expected, by reason of her size, to maintain in a high sea.

The "Bailey" is essentially a seagoing vessel. Her bunker capacity is deemed sufficient to enable her to steam three thousand knots at economical speed. In time of war she may be expected to accompany the battleship fleet, and to serve both as a scout and defense for the heavier vessels.

SUBMARINE TORPEDO BOAT "HOLLAND."

It is probable that the introduction of a successful submarine torpedo boat will mark one of the greatest revolutions that ever occurred in naval warfare, for there is a general belief that a thoroughly efficient under-water warship would have the above-water ship at its mercy. We think this belief is well founded. A submarine torpedo boat, because of its invisibility, is deadly by day and in the open—it will be doubly so by night. No searchlight would be powerful enough to detect the insignificant conning tower of an approaching submarine boat before it was well within striking range. No roadstead would be secure from its attack, and no fleet would dare to enter a harbor defended by these invisible, swiftly moving and destructive little craft; indeed, it is difficult to imagine just what would happen if a flotilla of such boats were dispatched against a fleet of the enemy's ships.

In 1895 Congress authorized the construction of a vessel of this type, the "Plunger," which is now being built from designs by her inventor, Mr. John P. Holland, at Baltimore, and will soon be completed. The "Plunger" is 85 feet long, 11½ feet diameter, and will steam at 16 knots speed on the surface and 10 knots when submerged. Her displacement will be 168 tons. Subsequent to the letting of the contract for the "Plunger" Mr. Holland constructed a smaller boat of the same type, which has just undergone a series of official tests in New York Bay and has given good satisfaction. The "Holland" (as she is called) is a smaller boat, being 55 feet long, 10¼ feet in diameter and of 75 tons displacement. The steel hull is of a blunt cigar shape. Two sources of motive power are furnished, a gas engine being used at the surface and a motor run by storage batteries when the boat is submerged. The storage batteries, which are of great weight, are located amidships. Above the storage batteries on each side of the ship are located the compressed air tanks, from which fresh air is supplied to the crew when the boat is submerged. The gas engine and electric motor operate a common shaft, the gas engine being located just ahead of the motor. This arrangement, it will be seen, enables the motor to be utilized as a generator for charging the batteries.



LONGITUDINAL SECTION THROUGH HOLLAND SUBMARINE BOAT.

The cellular bottom of the little vessel is utilized for the storage of the liquid fuel, and here are located the water-ballast tanks, which assist in trimming and in the operations of diving or rising to the surface. With the tanks filled and all the crew aboard there is a reserve buoyancy of 250 pounds, and the boat is caused to sink by altering the pitch of the horizontal diving rudders, the forward motion of the vessel, combined with the downward pitch of the rudders, combining to force her below the surface. She is maintained at the required depth by means of delicate automatic mechanism, similar to that used in the automobile torpedo.

The offensive powers of the "Holland" are very formidable. In the first place, she carries in her bow or nose an under-water discharge tube for launching the deadly Whitehead torpedo. She also carries two other discharge tubes for firing guncotton projectiles. Unlike the one just described, which lies in the longitudinal axis of the boat, these are upwardly inclined, one pointing forward and the other aft. The forward tube is called an aerial torpedo gun. It is capable of throwing a 100-pound guncotton shell a distance of three-quarters of a mile. The other tube, astern, is called an under-water torpedo gun, and it is capable of driving its shell with accuracy for a distance of 200 yards under water.

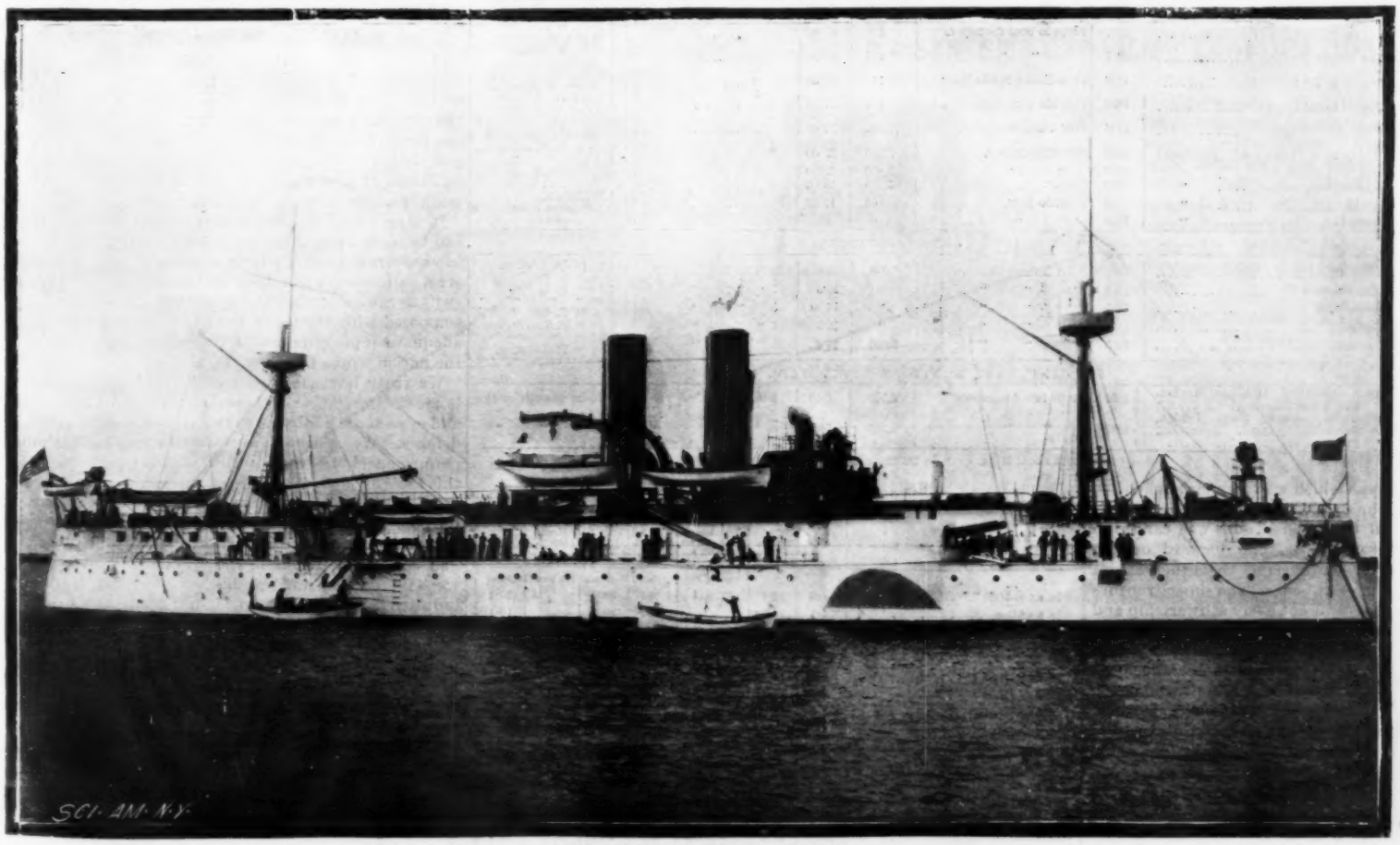
When the boat is at the surface of the water she can be steered by observation through the portholes of the conning tower. When she sinks below the surface a small tube, carrying at its top an inclined mirror or prism, in the manner of the camera lucida, will throw a picture of the surrounding waters upon a board in the conning tower. The vessel also carries a compass and an automatic gage showing the depth below the surface.

SECOND-CLASS BATTLESHIP "MAINE."

We feel that any description of the United States navy which failed to make mention of the ill-fated "Maine" would be guilty of an omission which the fact that this good ship is no longer in existence would scarcely excuse. Our reader will look for a cut of the unhappy vessel, whose appearance was as handsome as it is now familiar to the nation that mourns its loss. The lack of space prevents us from giving in this number such a full description of the "Maine" and the circumstances attending its destruction as we could wish, and, foreseeing this, we have published a special "Maine" SUPPLEMENT, in which the history of the vessel, from the laying of her keel-plates to the disaster in Havana Harbor, is given at full length.

The "Maine" was authorized in 1886, at the same time as the "Texas," which now forms part of the Flying Squadron at Hampton Roads. In the earlier days of her construction she was known as Armored Cruiser No. 1; but latterly she has appeared on the official register as a second-class battleship. Her hull was designed and built by the government, her keel being laid at the Brooklyn Navy Yard October 17, 1888. The engines were of government design, and were built by the N. F. Palmer, Jr., Company, of New York. They were of the vertical triple-expansion type, and they were the first of this type used in the new navy, the earlier ships having horizontal engines, lying well below the water line.

The "Maine" was an excellent representative of a



SECOND-CLASS BATTLESHIP "MAINE."

Displacement, 6,682 tons. **Speed**, 17·45 knots. **Maximum Coal Supply**, 896 tons. **Complement**, 374 men. **Armor**: Belt, 12 in.; deck, 2 in.; barbettes, 12 in.; turrets, 8 in. **Guns**: Main battery, four 10-in., six 6-in.; secondary rapid-fire battery, seven 6-pounders, eight 1-pounders, four Gatlings. **Torpedo tubes**, four. **Authorized** 1886. **Destroyed in Havana Harbor, February 15, 1898.**

TABLE OF THE NEW UNITED STATES NAVY.

Name.	Authorized.	Type of Ship.	Displacement.	Speed.	Armor.	Main Armament.
Atlanta, Boston,	1883	Protected cruiser.	3,000	15·6	1½ in. deck.	2 8-in. B. L. rifles. 6 6 " " 4 8 " " 8 6 " " 2 5 " "
Chicago	1883	" "	4,500	15·1	1½ " "	
Dolphin	1883	Dispatch boat.	1,486	15·5		2 4 " R. fire " 2 8 " B. L. "
Charleston	1885	Protected cruiser.	3,730	18·30	2 " to 3 in. deck.	6 6 " " "
Newark	1885	" "	4,098	19·00	2 " " 3 " "	12 6 " " "
Petrel	1885	Gunboat.	892	11·8	⅜ " " ¾ " "	4 6 " " "
Yorktown	1885	"	1,710	16·14	⅜ " deck.	6 6 " " " 4 10 " " "
Maine	1886	Turret battleship.	6,682	17·45	8 " to 12 in.	6 6 " " " 2 12 " " "
Texas	1886	" "	6,315	17·00	12 "	6 6 " " "
Baltimore	1886	Protected cruiser.	4,413	20·09	2½ " to 4 in. deck.	4 8 " " " 6 6 " " "
Vesuvius	1886	Dynamite "	929	21·42	1 " deck.	3 15 " dynamite guns.
Cushing	1896	Torpedo boat.	105	22·5		3 1-pounder R. F. 3 18-in. torpedoes.
Monterey	1887	Monitor.	4,084	13·6	7½ " to 13 in.	2 12 " B. L. rifles. 2 10 " " "
Philadelphia	1887	Protected cruiser.	4,324	19·68	2½ " " 4 " "	12 6 " " "
San Francisco	1887	" "	4,098	19·53	2 " " 3 " "	12 6 " " "
Bennington	1887	Gunboat.	1,710	17·5	⅜ " deck.	6 6 " " "
Concord	1887	"	1,710	16·8	⅜ " "	6 6 " " "
New York	1888	Armored cruiser.	8,200	21·00	3 " to 6 in. deck. 4 " " 10 "	6 8 " " " 12 4 " R. F. "
Olympia	1888	Protected "	5,870	21·78	2 " " 4¾ " "	4 8 " B. L. " 10 5 " R. F. "
Cincinnati	1888	" "	3,213	19·00	1 " " 2½ " "	1 6 " " rifle. 10 5 " " rifles.
Detroit	1888	Cruiser.	2,089	18·71	½ " " ½ " "	9 5 " " "
Marblehead	1888	"	2,089	18·44	½ " " ½ " "	9 5 " " "
Montgomery	1888	"	2,089	19·05	½ " " ½ " "	9 5 " " " 1 6 " " "
Raleigh	1888	Protected cruiser.	3,213	19·00	1 " " 2½ " "	10 5 " " " 4 4 " R. F. "
Bancroft	1888	Training ship.	830	14·37	¼ " " ⅛ " "	4 6-pounder R. F.
Katahdin	1889	Harbor defense ram.	2,155	16·25	3 " " 6 " "	8 4-in. R. F.
Castine	1889	Gunboat.	1,177	16·08	⅝ " " ⅝ " "	8 4 " "
Machias	1889	Gunboat.	1,177	15·5	⅝ " " ⅝ " "	4 13-in. B. L. rifles. 8 8 " " " 4 6 " " "
Indiana	1890	Coastline battleship.	10,288	15·55	6 " " 18 "	
Massachusetts	1890	" "	"	16·15	do.	do.
Oregon	1890	" "	"	16·78	do.	do.
Columbia	1890	Protected cruiser.	7,375	22·8	2½ " " 4 " "	1 8 " B. L. rifle. 2 6 " R. F. rifles. 8 4 " " "
Ericsson	1890	Torpedo boat.	120	24·00		3 1-pdr. " " 1 8-in. B. L. rifle.
Minneapolis	1891	Protected cruiser.	7,375	23·07	2½ " " 4 " "	2 6 " R. F. rifles. 8 4 " " "
Iowa	1892	Seagoing battleship.	11,410	16·00	6 " " 15 "	4 12 " B. L. " 8 8 " " " 6 4 " R. F. " 8 8 " B. L. "
Brooklyn	1892	Armored cruiser.	9,271	21·07	3 " " 6 " " 4 " " 8 " "	12 5 " R. F. " 8 4 " " "
Helena, Nashville and Wilmington	1893	Gunboats.	1,392	16·00	½ " " ⅝ " "	2 torpedo tubes.
Submarine boat—Plunger	1893	Torpedo boat.	168	8·00		3 1-pdr. R. F. guns. 3 18-in. Whiteheads.
Nos. 3, 4 and 5*	1894	" "	142	24·5		4 13-in. B. L. rifles. 4 8 " " " 14 5 " R. F. guns, do.
Kearsarge†	1895	Seagoing battleship.	11,525	16·00	9 " " 17 "	
Kentucky†	1895	" "	11,525	16·00	do.	do.
Annapolis	1895	Composite gunboat.	1,000	13·17	Unarmored.	6 4-in. R. F. rifles.
Marietta	1895	" "	1,000	13·03	do.	do.
Newport	1895	" "	1,000	12·29	do.	do.
Princeton	1895	" "	1,000	12·00	do.	do.
Vicksburg	1895	" "	1,000	12·71	do.	do.
Wheeling	1895	" "	1,000	12·88	do.	do.
Nos. 6*, 7*, 8* †	1895	First-class torpedo boats.	190	28·5	do.	3 18-in. Whiteheads. 4 1-pdr. R. F. guns.
Alabama, Wisconsin, Illinois †	1896	Sea-going battleships.	11,525	16·00	6 in. to 18 in.	4 13-in. B. L. rifles. 14 6-in. R. F. rifles.
Nos. 9, 10* †	1896	First-class torpedo boats.	146	30·5		2 18-in. Whiteheads. 4 1-pdr. R. F. rifles.
No. 11* †	1896	" "	273	30·00		2 18-in. Whiteheads. 4 6-pdr. R. F. guns.
Nos. 12* †, 13* †, 14*	1896	Second-class torpedo boats.	132	22½		3 18-in. Whiteheads. 3 1-pdr. R. F. guns.
Nos. 15†, 16*	1896	" "	46	20·00		2 18-in. Whiteheads. 1 1-pdr. R. F. gun.
Nos. 17, 18* †	1896	" "	65	20·00		2 18-in. Whiteheads. 1 1-pdr. R. F. gun.
No. 19* †	1897	Torpedo boat destroyer.	340	30·00		2 18-in. Whiteheads. 7 6-pdr. R. F. guns.
Nos. 20, 21* †	1897	" "	240	30·00		2 18-in. Whiteheads. 4 6-pdr. R. F. guns.
Nos. 22 to 33* ‡	1898	First-class torpedo boats.	150	27·00		2 18-in. Whiteheads. 4 1-pdr. R. F. guns.
Nos. 34 to 52* ‡	1898	Torpedo boat destroyers.	400	32·00		2 18-in. Whiteheads. 8 6-pdr. R. F. guns.
Three Battleships‡	1898	First-class, sea-going.	12,000	16·00		Latest types of heavy and rapid-fire guns.
New Orleans (Amazonas)	Purchased 1898	Protected cruiser.	3,000	21·00		6 6-in. R. F. rifles. 4 5·7-in. " "
Albany (Abrouil)	" 1898	" "	3,600	21·00		do.
Topeka (Diogenes)	" 1898	Cruiser.	1,800	16·00		
Manley	" 1898	Torpedo boat.	46	17·00		1 Whitehead. 2 Hotchkiss guns.
Somers	" 1898	" "	(?)	(?)		(?)

COAST DEFENSE MONITORS.

Amphitrite	1885	Coast defense monitor.	3,990	10·5	5 in. to 11½ in.	4 10-in. B. L. rifles. 2 4 " R. fire " 4 10 " B. L. "
Miantonomoh	1885	" " "	"	10·5	7 " " 11½ "	
Monadnock	1885	" " "	"	12·00	5 " " 11½ "	4 10 " " " 2 4 " R. fire " 4 10 " B. L. "
Terror	1885	" " "	"	10·5	7 " " 11½ "	
Puritan	1885	" " "	6,060	12·4	10 " " 14 "	4 12 " " " 6 4 " R. fire guns.

SINGLE-TURRET MONITORS (CIVIL WAR).

Ajax, Canonicus, Mahopac, Manhattan, Wyandotte	1862	Single-turret monitors.	2,100	6·00	5 in. to 10 in.	2 15-in. smooth-bores.
Comanche, Catskill, Jason, Lehigh, Montauk, Nahant, Nantucket, Passaic	1862	" "	1,875	5½	5 " " 11 "	2 15 " " "

* See torpedo boat table. † Building. ‡ Authorized.

type which was popular at the time she was designed. Her main battery of four 10-inch guns was carried in two turrets, one forward on the starboard beam, the other aft on the port beam. The superstructure deck was cut away athwartship and fore and aft to allow the four guns to be concentrated ahead, astern or on either beam—an arrangement similar to that on the Brazilian ship "Riachuelo," to which she bore some resemblance. She also carried six 6-inch guns, four on the main deck, fore and aft, and two on the superstructure deck, besides a numerous rapid-fire battery. She had a speed of 17·45 knots, and altogether she was an efficient ship that could ill be spared from our navy. The "Maine" was sent to Havana Harbor in consequence of certain riots which imperiled the safety of American residents on January 25, 1898, and was assigned to an anchorage at a particular buoy, where three weeks later, on the night of February 15, she was blown up and completely destroyed, and the lives of 266 of her crew were lost. A Court of Inquiry of the United States navy, after an exhaustive investigation, found that, "in the opinion of the court, the 'Maine' was destroyed by a submarine mine, which caused the partial explosion of two or more of her magazines."

UNITED STATES NAVAL ORDNANCE.

NATURE OF GUN.	Caliber.	Weight.	Total Length.	Weight of Service-charge (Cool Smokeless Powder.)	Weight of Projectile.	Muzzle Velocity (Service).	Muzzle Energy.	Perforation of Wrought Iron at Muzzle.†
	Inch.	tons.	feet.	lbs.	lbs.	ft.-seconds.	ft.-tons.	Inch.
4-in. B.L.R., Mark I.	4	1·5	13·7	12 to 14	33	2000	915	10·1
4-in. B.F.* Gun	4	1·5	13·7	..	33	2000	..	10·1
5-in. B.L.R., Mark I.	5	2·8	15·5	28 to 29	60	2000	1,660	12·0
5-in. B.F.* Gun	5	3·1	17·4	28 to 30	50	2300	1,824	13·0
6-in. B.L.R., Mark I.	6	4·8	15·8	50	100	2000	2,773	..
6-in. B.L.R., Mark II.	6	4·9	16·1	45 to 48	100	2000	..	14·0
6-in. B.L.R., Mark III., of 30 Cals.	6	4·8	16 3	44 to 47	100	2000	..	..
6-in. B.L.R., Mark III., of 35 Cals.	6	5·2	18·8	..	100	2080	2,990	14·8
6-in. B.L.R., Mark III., of 40 Cals.	6	6·0	21·3	..	100	2150	3,704	15·6
8-in. B.L.R., Mark I.	8	(12·3) (12·9)	21·5	105 to 115	250	2000	6,932	19·4
8-in. B.L.R., Mark II.	8	13·0	21·5	..	250	2000	..	19·4
8-in. B.L.R., Mark III., of 35 Cals.	8	13·1	25·4	..	220	2080	7,498	20·6
8-in. B.L.R., Mark III., of 40 Cals.	8	15·2	28·7	..	250	2150	8,011	21·6
10-in. B.L.R., Mark I., of 30 Cals.	10	25·7	27·4	225 to 240	500	2000	13,864	24·0
10-in. B.L.R., Mark I., of 35 Cals.	10	(27·1) (28·2)	30·5	..	500	2000	14,709	25·8
10-in. B.L.R., Mark II., of 30 Cals.	10	23·1	27·4	..	500	2000	13,864	24·0
10-in. B.L.R., Mark II., of 35 Cals.	10	27·6	31·2	..	500	2100	15,235	26·6
12-in. B.L.R., Mark I.	12	45·2	.36 8	425	850	2100	25,985	31·5
13-in. B.L.R., Mark I.	13	60·5	40 0	550	1160	2100	33,627	34·8

TORPEDO BOATS BUILT, BUILDING OR AUTHORIZED.

Name.	Authorized.	Displacement, Tons.	Speed.
1 Cushing	1896	105	22·5
2 Ericsson	1890	120	24·0
Plunger†	1893	168	8·0
Stiletto	..	31	18·2
3 Foote	1894	142	24·5
4 Rodgers	"	142	24·5
5 Winslow	"	142	24·5
6 Porter	1895	190	28·6
7 Du Pont	"	190	28·5
8 Rowan†	"	182	26·0
9 Dahlgren†	1896	146	30·5
10 T. A. M. Craven†	"	146	30·5
11 Farragut†	"	273	30·0
12 Davis†	"	132	22·5
13 Fox†	"	132	22·5
14 Morris	"	108	24·5
15 Talbot†	"	46	20·0
16 Gwin	"	46	20·0
17 Mackenzie†	"	65	30·0
18 McKee†	"	65	20·0
19 Stringham†	1897	340	30·0
20 Goldsborough†	"	247	30·0
21 Bailey†	"	235	30·0
22 to 33 Torpedo Boats‡	1898	150	27·0
34 to 52 Destroyers‡	"	400	31·0
Manley	Purchased 1898	46	17·0
Somers	"	(?)	(?)

† Building. ‡ Authorized.

THE AUXILIARY NAVY.

Name.	Class.	Rapid-fire battery.	Tonnage.	Speed in knots per hour.
St. Louis	Cruiser.	12 6-in.	11,629	21
St. Paul	"	12 6-in.	11,629	21
Yale (Paris)	"	12 5-in.	10,500	20
Harvard (New York)	"	12 5-in.	10,500	20
Nictheroy	"	1 4·7-in. 1 dynamite gun. 3 torpedo tubes.	5,000	19
Yankee, Prairie, Dixie, Yosemite	"	10 5-in. 6 6-pounders.	4,000	14·5
Yorktown	"		2,808	..
Venezuela	"		2,842	..
Yumuri	"		3,498	..
Juniata	Repair ship.		4,080	..
Niagara	"		2,265	..
Mayflower	Torpedo gunboat.	2 5-in., 12 6-pdr.	1,475	18·8
Scorpion	Gunboat.	4 5-in., 6 6-pdr.	627	17·8
Five converted yachts	"	1 and 6-pdr.	300 to 550	16 to 18
Thirteen converted tugs	Scout boats.	1-pdr. and 6-pdr.	100 to 380	.. to ..
Six colliers	Coal supply.	6-pounders.	1,000 to 2,700	12 to 14
Solace	Hospital.		3,800	..
Namshaw	Store ship.		2,300	..
Three lighthouse tenders	Patrol.	Small rapid-fire.	400 to 600	.. to ..
Sixteen revenue cutters	"	"	200 to 1,200	.. to ..

NOTE.—The auxiliary fleet is being steadily increased as we go to press.

It will be noticed that the tables include the three battleships of 12,000 tons and the twelve torpedo boats and eighteen destroyers recommended by Congress this year, giving a complete statement of the strength of our modern navy. As we have shown elsewhere, the completion of the present programme of construction will strengthen it where it has hitherto been somewhat weak, namely, in battleships and torpedo boats.

It is an excellent fleet, and the worst criticism that can be made upon it is that it is altogether inadequate in numbers to properly represent one of the most powerful nations on earth. Powerful as are our battleships, swift as are our cruisers, they do not in the aggregate, compared with the other navies of the world, give an adequate representation of the wealth and power of the nation whose flag they carry.

We trust, however, that recent events have brought home to Congress the imperative necessity for large and systematic additions to this right arm of a nation's defense. We venture to say—and we take the splendid performance of the various ships as shown in the pages of this issue as our witness—that there are no appropriations of the public money that are granted to better purpose than those for the upbuilding of our new navy. Not merely have we created an entirely new and efficient fleet, but in the very act of construction we have opened and established new and profitable industries. The work turned out from such firms as the Carnegie Steel Company, the Bethlehem Iron Company, the Carpenter Steel Company and from our arsenals at Washington and Watervliet, has earned a world-wide celebrity and has exercised a powerful formative influence upon the science and art of naval design and construction the world over.

We can scarcely close without a reference to the crisis which, all unexpectedly, is about to put our new navy to the test of actual conflict. We regard the issue with complacency, partly because of the excellence of our ships, but chiefly because of the splendid efficiency and courage of the officers and men to whose care the ships are intrusted.

To assist the reader in following the various naval and military operations of the Cuban campaign we have prepared the very accurate and detailed map which accompanies this issue.

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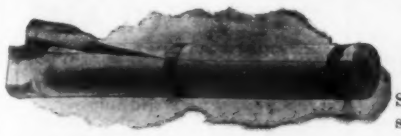

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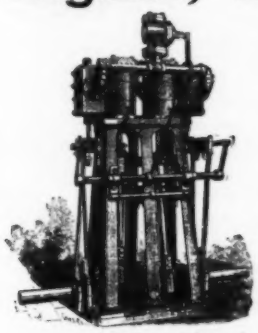

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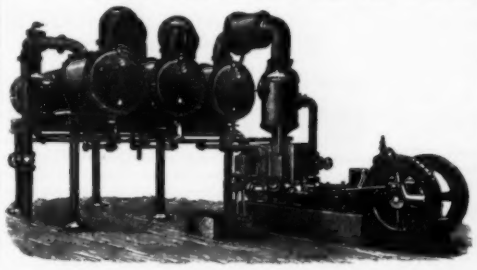

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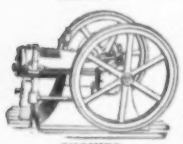

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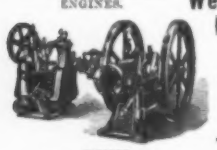

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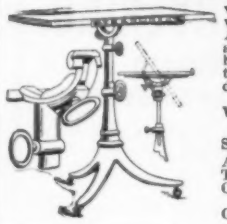

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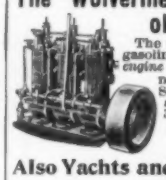

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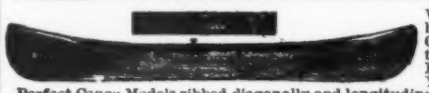

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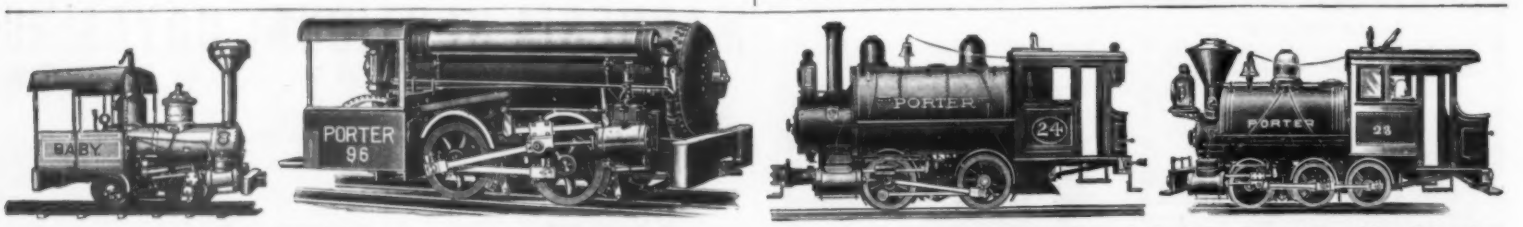

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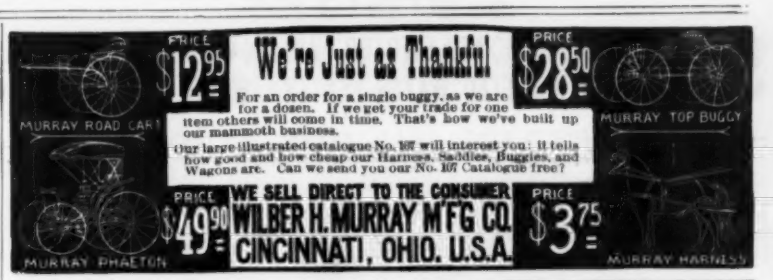
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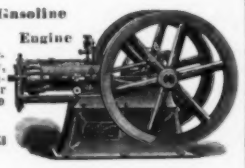

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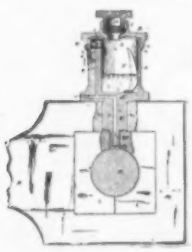

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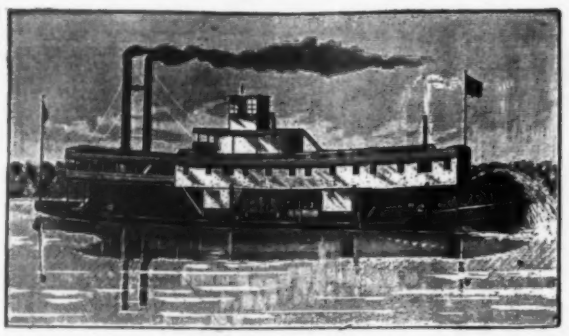

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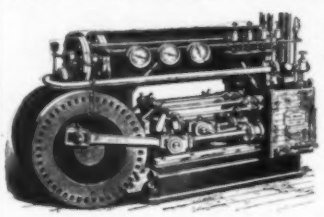

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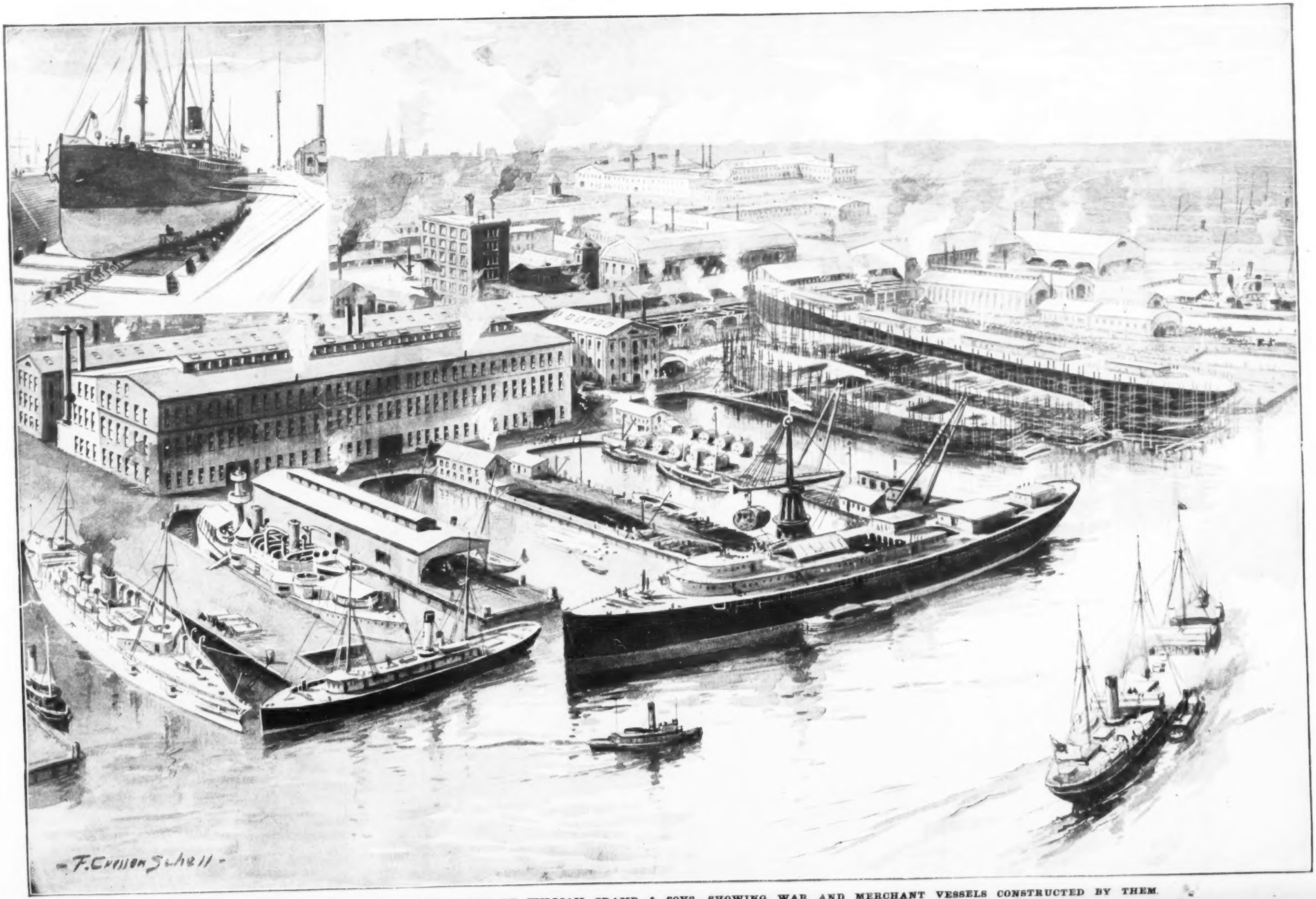

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